Mathematics 8

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Unit 6

Linear Equations and Graphing

we encourage

Alberta Education

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Unit 6: Linear Equations and Graphing
Student Module Booklet
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This document is intended for	
Students	✓
Teachers	✓
Administrators	
Home Instructors	
General Public	
Other	

You may find the following Internet sites useful:

- Alberta Education, **http://www.education.gov.ab.ca**
- Learning Resources Centre, **http://www.lrc.education.gov.ab.ca**
- Tools4Teachers, **http://www.tools4teachers.ca**

Exploring the electronic information superhighway can be educational and entertaining. However, be aware that these computer networks are not censored. Students may unintentionally or purposely find articles on the Internet that may be offensive or inappropriate. As well, the sources of information are not always cited and the content may not be accurate. Therefore, students may wish to confirm facts with a second source.

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Unit 6: Linear Equations and Graphing

Unit 6 Introduction

If you could take any holiday in the world, where would you go? What would you do? Would it be an exciting physical adventure package, a wildlife viewing eco-tourism experience, a tour of European cities, or a relaxing time with sand and surf?

Your enjoyment of the trip would likely increase if all aspects were carefully planned ahead of time. Some factors in your planning are definitely related, such as the distance you travel, the cost, and the length of your holiday. The relationships between factors can often be shown in graphs and depicted by mathematical equations.

In this unit you will use tables and graphs to analyze data and look for relationships. You will also solve problems involving linear relations. You will also use linear equations to model problems and to solve them.

This unit will help you answer the following critical question: How can equations help in planning an eco-travel or adventure trip?

The new concepts and skills dealing with linear relations involving graphs, tables of values, and equations will be presented in seven lessons.

Mathematics 8 LearnEveryWare

Unit 6: Linear Equations and Graphing

Lesson 1: Analyzing Graphs of Linear Relations

Lesson 2: Patterns in a Table of Values

Lesson 3: Linear Relations

Lesson 4: Modelling and Solving One-Step Multiplication and Division Equations

Lesson 5: Modelling and Solving Two-Step Multiplication Equations

Lesson 6: Modelling and Solving Two-Step Division Equations

Lesson 7: Modelling and Solving Two-Step Distributive Property Equations

In this unit there are a variety of assignments you will be asked to complete. Some of these include

- posting and responding to the discussion board
- adding samples of your work to your Math 8 folder
- completing sets of questions for each lesson
- solving a unit problem at the end of the unit
- completing evaluation pieces assigned by your teacher

Strategies for Success

In order to ensure your success in this unit, follow these strategies.

Strategy 1

Make the foldable study tools according to the detailed instructions on pages 330 and 368 of your textbook. Although these activities may not be for marks, you will benefit from these tools. Keep these points in mind as you develop and use these study tools:

- Add strategies, examples, and vocabulary words as you are working through the lessons.
- The foldables can serve as quick reference guides and will help you save time when you are ready to study for your unit test.

Strategy 2

In this unit, you will be referring to pages 328 to 405 of your textbook.

- Take time to flip through these textbook pages.
- Look at illustrations, margin features, and main titles to get a sense of where you will be going.

Strategy 3

Read your lessons and textbook materials carefully.

- Pay special attention to graphs, tables, and diagrams. They are critical in this unit.
- Read and reread material. Take time to understand it.
- Ask yourself: What material is new to me? What do I already know?
- Move ahead with confidence.

Unit 6 Problem

This Unit will be capped off with a project. You will be asked to plan an adventure trip or eco-travel opportunity. To accomplish this, it will be necessary to collect some research material about the trip you are planning. Your information has to be presented as a linear relationship in a table and a graph.

For a preview of the Unit Problem, look ahead to "Math Link" on page 331 and "Wrap It Up!" on page 363 of your textbook.

Start thinking about your problem now and continue to think about it as you work through your lessons. That way, as you are learning, you are also getting ready to complete your project. In addition, you will be asked to describe in detail how the five types of equations you will be studying in this unit relate to different aspects of your trip. See how this describing task is explained in "Wrap It Up!" on page 403 of your textbook.

At the end of the sections in the textbook (e.g., 9.1 or 9.3), there are "Math Link" features. In these "Math Link" features, there are some questions involving different types of adventure or travel opportunities. You might want to consider these types of vacations when completing your project. Answering these "Math Link" questions will help you complete the Unit 6 Problem.

Unit 6: Linear Equations and Graphing

Lesson 1: Analyzing Graphs of Linear Relations

Get Focused

A hot, fresh pizza with all the toppings is almost irresistible. The appetizing aroma, the attractive colours, and the variety of shapes and textures stimulate the appetite. It can make you hungry just thinking about it. The price of some pizzas increases with the quality and number of toppings used. This situation will be represented in this lesson by a graph, a model, and in a data table.

© nolie/shutterstock

In this lesson, you will increase your ability to understand the meanings of graphs and to describe the graphs and their meanings in words. You will create tables of values from the graphs and describe the patterns of the values depicted. You will even be able to predict values not plotted on a graph to include in its table of values.

This lesson will help you answer the following critical question: How do you interpret a linear relation graph so it can be easily understood?

To complete the activities in this lesson, you will need a cardboard circle and some coloured counters. If these are not available, a plate and different coins will work.

Assignments

Your assessment will consist of the following:

- posting and responding to the discussion board
- adding to your Math 8 course folder
- completing Unit 6: Lesson 1 Question Set

Explore

How would you react if you went to buy a pizza and the menu had a large graph showing the cost rather than a price list? Some people would appreciate it for the meaning it gives; whereas others would be upset because it is different than what they are used to seeing.

Try This

TT 1. How well could you understand a pizza price graph? Give it a try by working through "Explore the Math" and completing questions 1, 2, 3, and 4 on pages 332 and 333 of your textbook.

Pay special attention to "Literacy Link" in each margin. They will help you understand the terms **relationship** and **table of values**—words used throughout this unit.

relationship: a pattern formed by two sets of numbers

table of values: a chart showing two sets of related numbers

Working with a partner for this activity may be beneficial. Ask your teacher about the possibility of working with a partner.

To demonstrate your understanding, complete the following Try This questions about the cost of Tony's Large pizza and toppings.

You may find Construct a Table has helpful hints for creating a table using a Word document.

Construct a Table

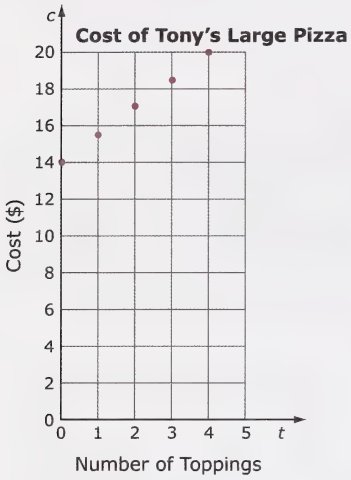
If you want to construct a table in a Word document, decide how many rows and how many columns you want. Then follow these steps:

Word 2003	Word 2007
step 1: Click on the Table menu in the toolbar. **step 2:** Select "Insert." **step 3:** Select "Table." **step 4:** Fill in the number of columns and rows you will need, and select "AutoFit to contents."	**step 1:** Click on the "Insert" tab at the top of your screen. **step 2:** Click on the Table button. **step 3:** Use the visual representation to choose the number of rows and columns, or select "Insert Table." **step 4:** If you selected "Insert Table," enter the number of columns and rows you will need, and select "AutoFit to contents."

step 5: Click OK.

step 6: Fill in the cells in the table.

step 7: If you need to make adjustments to the table, click once in the table; then click on the Table menu, and select "Table Properties." Choose the aspect of the table you want to adjust. If you don't like the change, press Control + Z. This will undo the change.



TT 2. Using the graph above, what is the cost of Tony's large pizza with no toppings?

TT 3. What is the cost of Tony's large pizza with four toppings?

TT 4. What is the cost of each topping on a large pizza at Tony's?

TT 5. Make a table of values from the graph to the left.

TT 6. What is the cost of Tony's large pizza with five toppings?


Place a copy of your answers in your Math 8 course folder.

Discuss and Share

Create your own question about the graph of pizza prices and post it to the discussion board along with your responses to questions 1 to 4 of "Explore the Math." Then respond to at least two other student postings by answering the questions they created. Did you receive a variety of answers to your posting or were they quite similar?

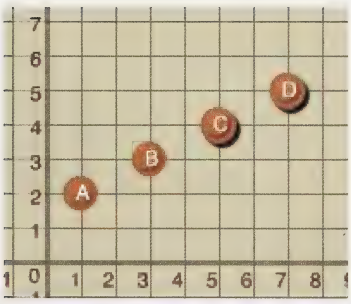
Read

Did the table of values help you better understand the graph and make predictions? To increase your ability to make more effective tables of values, study "Example 1: Make a Table of Values From a Graph" on page 334 of your textbook. See how a horizontal table is used. You may continue to use a vertical table, as shown on page 333, if you prefer.

Watch and Listen

You can analyze the graphs of linear relations using the resource "Linear Equations," available on the Math 8 Multimedia DVD. Using the directions presented in this resource, plot several points on the grid. Place the first point somewhere close to the centre of the grid. Then place several other points according to a pattern such as 2 units to the right and 1 unit up.

The following dots are placed according to this sample pattern.



You will notice that after points A and B are placed, any additional points must follow the pattern established by these points. Otherwise the additional points will not stay on the grid.

When you have placed several points according to your pattern, confirm that they describe a linear relation by clicking Draw Line button.

Self-Check

SC 1. Answer questions a. to d. of "Show You Know" on page 334 of your textbook to practise what you have studied.

Compare your answers in the Appendix.

Read

You have improved your skills of constructing a table of values from a graph by studying "Example 1" and completing "Show You Know." How are your skills of accurately analyzing a graph? Get some more pointers by reading "Example 2: Analyse Data on a Graph of a Linear Relation" on page 335 of your textbook. Pay special attention to "Literacy Link" in the margin regarding **linear relations**.

linear relation: a pattern made by a set of points on a graph that lie in a straight line

Self-Check

SC 2. Answer questions a. to d. of "Show You Know" on page 335 of your textbook to demonstrate that you have the skills down.

Compare your answers in the Appendix.

Read

Study "Key Ideas" on page 336. Transfer the important ideas you have gained to your foldable. If you have yet to build your foldable for this unit, refer to the directions on page 330 of your textbook. As mentioned earlier, there will be two foldables for this unit. Use the first foldable to record the important ideas from the first three lessons as you encounter them. The important ideas from the last four lessons will go in the second foldable. These foldables make great study guides; so, it is definitely worth the effort to create and keep your foldables!

Connect

Now that your skills of analyzing graphs are stronger, how about applying them to the world around you? Put those skills to work by completing the Self-Check questions below.

Self-Check

SC 3. Complete questions 1 and 3 of "Communicate the Ideas" on page 337 of your textbook.

SC 4. Complete "Check Your Understanding" questions 4, 6, 9, 11, 13, 15, and 16 on pages 337 to 340 of your textbook.

If you are having difficulty with any of the questions, discuss them with a partner or with your teacher. Make sure you are confident in how to do each question accurately.

Compare your answers in the Appendix.

Extra Practice

If you accurately answered at least seven of the questions in SC 3 and SC 4 and have a solid understanding of how to build tables of values and interpret graphs, go on to the assignment. If you need a bit more practice with the concepts of this lesson, complete questions 5, 7, 8, 10, 12, and 14, of "Check Your Understanding" on pages 337 to 341 in your textbook. Brief answers are provided on pages 501 and 502 of your textbook. If you are struggling with any of the concepts, be sure to contact your teacher for additional help.

Assignment

Go to the Unit 6 Assignment Booklet and complete "Unit 6: Lesson 1 Question Set."

Try This

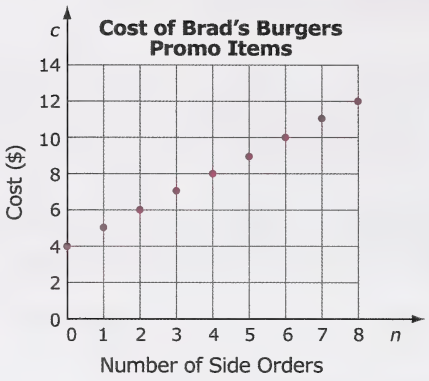
TT 7. Complete "Math Link" on page 341 of your textbook. This is an example of some of the calculations and questions you will do in the Unit 6 Problem. This particular trip could be exciting enough that you would want to select it as your adventure trip.

Place a copy of your answers in your Math 8 course folder.

Lesson Summary

In this lesson you analyzed graphs of linear relationships. These are graphs where the pattern made by the points is a straight line. You learned to represent the meaning of graphs using models, words, and tables of values.

When you constructed a table of values, the upper-left cell of the table contained the same label as the horizontal axis of the graph. The labels of the tables always indicated the units, if any, that described the numbers represented in the graphs.



Number of Side Orders	0	1	2	3	4	5	6	7	8
Cost ($)	4	5	6	7	8	9	10	11	12

You discovered how in some graphs it is possible to have points in between those shown on the graph. You were given opportunities to determine whether that would be appropriate for graphs representing different situations. You thereby determined that inserting points in between those shown is not appropriate for all graphs; so, it is important to look at both the units and the specific situation each graph describes when determining whether or not it is appropriate to have points between those shown on a graph.

You will build upon the skills learned in Lesson 1 in the lessons that follow.

Unit 6: Linear Equations and Graphing

Lesson 2: Patterns in a Table of Values

Get Focused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Rhiannon is looking at coloured fabric for a head scarf. The samples show a variety of shapes, patterns, and colours. How many of these samples have a linear pattern? What other patterns can you detect? Part of being human is that our brains look for patterns in what we see, hear, and experience. Life itself is sometimes like an interesting puzzle to solve.

In Lesson 1 you constructed data tables from graphs of linear relationships. In this lesson will look for patterns in tables of values and learn how to tell if the patterns represent a linear relationship. You will increase your ability to represent linear relationships in tables, graphs, words, ordered pairs, and mathematical expressions. The central emphasis in this lesson is to create accurate graphs from tables of values and describe the patterns of the values in expressions. By the end of this lesson, you will even be able to solve problems using expressions derived from tables of values.

This lesson will help you answer the following critical questions:

- How can you tell if a table of values represents a linear relation?
- How do you make a graph from a table of values?

To complete the activities in this lesson, you will need 1-cm grid paper and a ruler. Go to the Math 8 Multimedia DVD and open "1-cm Grid Paper" when you need it.

Assignments

Your assessment will consist of the following:

- posting and responding to the discussion board
- adding to your Math 8 course folder
- completing Unit 6: Lesson 2 Question Set

Explore

You were probably fairly good at seeing patterns in the fabric samples Rhiannon was looking at. How about looking for patterns in geometric figures and tables of values? You will give it a try by working through "Explore the Math" on pages 342 and 343 of your textbook. First, carefully read the "Literacy Link" notes in the margin on page 343. Understanding the definitions for **variable** and for **expression** will be essential in this unit. You will be using variables such as x, y, t, and n in every Unit 6 lesson and putting them into expressions such as $3x + 4y$. You will need to know what the words *variable* and *expression* mean when you read them.

variable: a letter chosen to represent an unknown quantity

For example, in the expressions $4a - 5$, the letter a is the variable.

expression: a single number or single variable, or a combination of mathematical operations involving numbers and variables without an equal sign

For example, each of the following is an expression: 6, n, $7x$, $4y - 5$.

Try This

TT 1. Answer "Explore the Math" questions 1, 2, 3, 4, 5, 6, and 7 on pages 342 and 343 of your textbook. Working with a partner for this activity will help you learn these math concepts. Your partner should be someone you can talk to about the activity as you do it, not just someone who will check your work. **Note:** In question 4, the chart has the heading "Number of Vertical Segments." This means vertical lines—how many vertical lines are in the section.

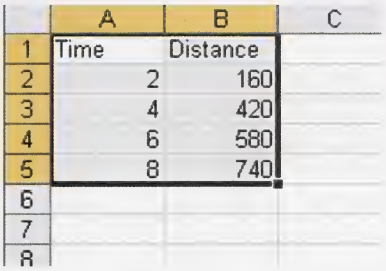
To demonstrate your understanding, complete the following Try This questions about how Adam's paycheque increases as he works overtime. Discuss your answers with a partner before you post them.

If you want to use the computer to construct a graph, consult the help function in the spreadsheet. If your computer has Microsoft® Excel 2007 or Microsoft® Excel 2003, there are easy to follow directions for making graphs. See the instructions that follow. Paper graphs are also fine. If you are submitting your lessons digitally, you will have to scan your paper graphs in order to send them to your teacher or to post them to the discussion board.

Using Excel® 2003 for Graphs

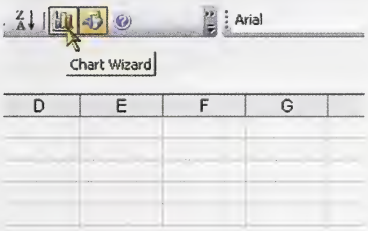
Line Graph

Type in your data (i.e., the heading and the numbers), and then highlight your data.

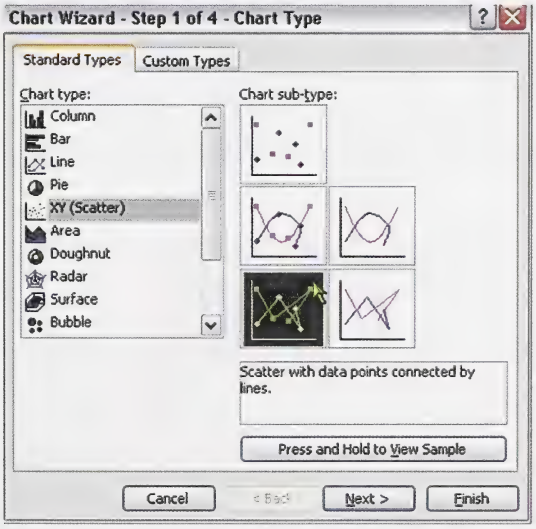


	A	B	C
1	Time	Distance	
2	2	160	
3	4	420	
4	6	580	
5	8	740	
6			
7			
8			

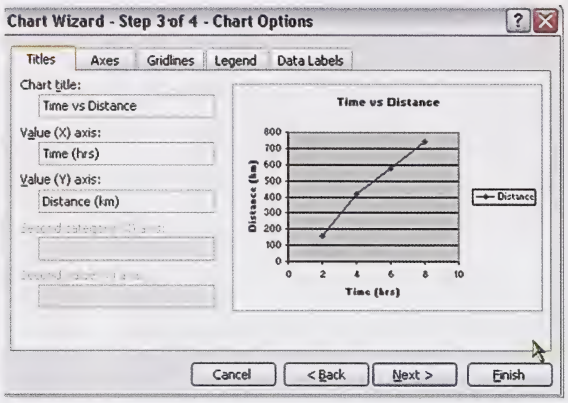
With the data highlighted, click on the "Chart Wizard."



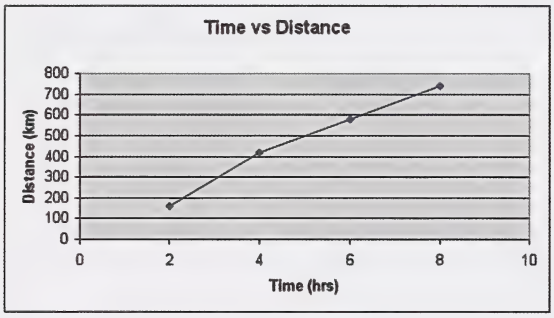
Always select "XY (Scatter)" for a line graph. If you want a straight line connecting the points, then choose the appropriate picture on the right side



Add in your title, and label both the *x* axis and the *y* axis.



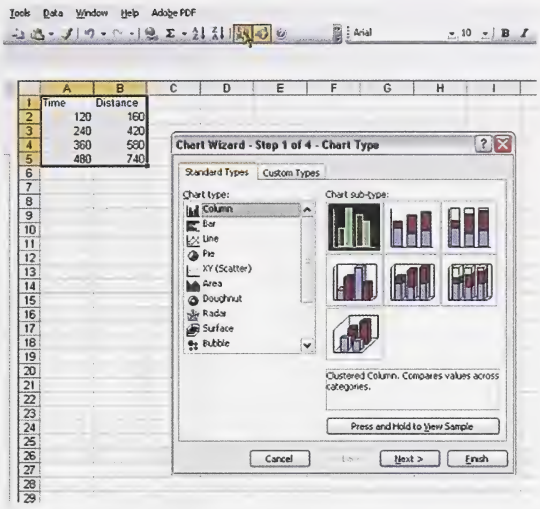
This is what your line graph should look like.



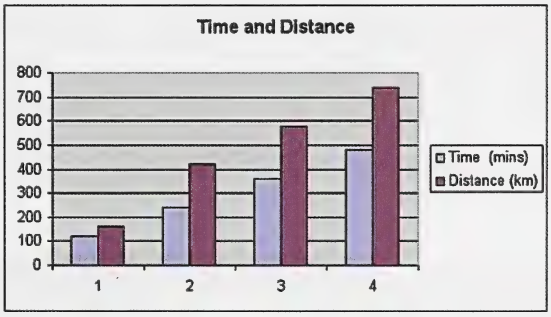
Bar Graph

Follow the same initial steps as you followed for the line graph.

Type in data, and then highlight and click on "Chart Wizard." For a bar graph, however, you choose the "Column Graph." You will then get vertical bars.

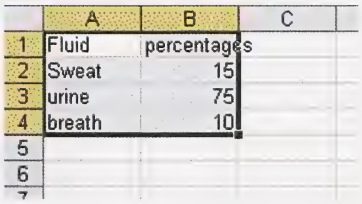


Your graph should end up something like this.



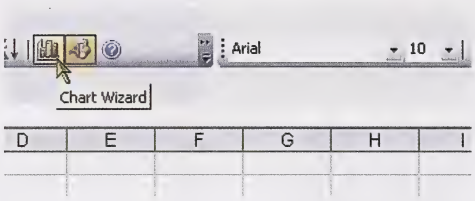
Pie Chart

First, type in the proper headings and numbers. Then highlight your data.

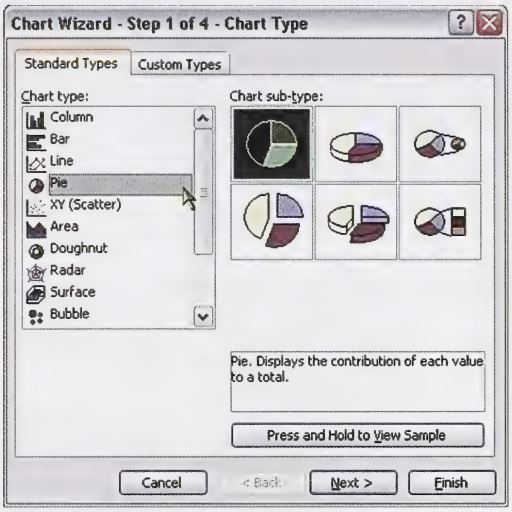


	A	B	C
1	Fluid	percentages	
2	Sweat	15	
3	urine	75	
4	breath	10	
5			
6			

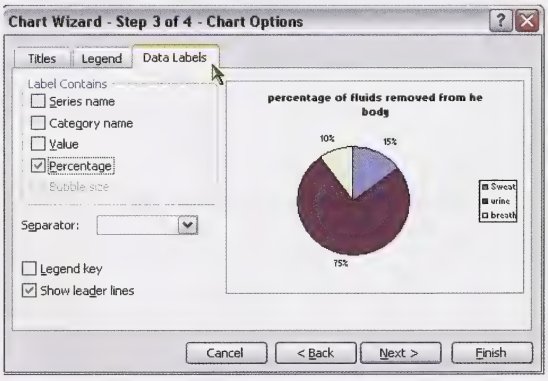
Next, click on the "Chart Wizard."



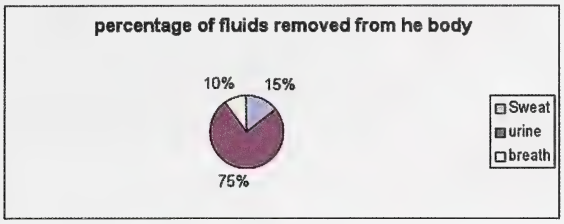
In order to create a pie chart, select "Pie."



Follow the steps. When you arrive at this window, you can have your graph show the percentages or the numbers you use.



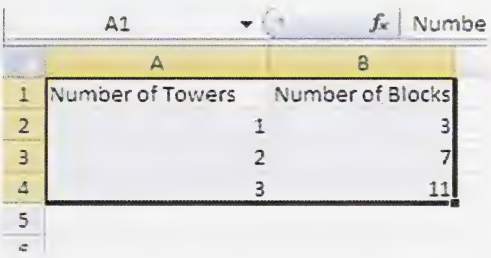
Your completed pie chart should look like the following.



Using Excel® 2007 for Line Graphs

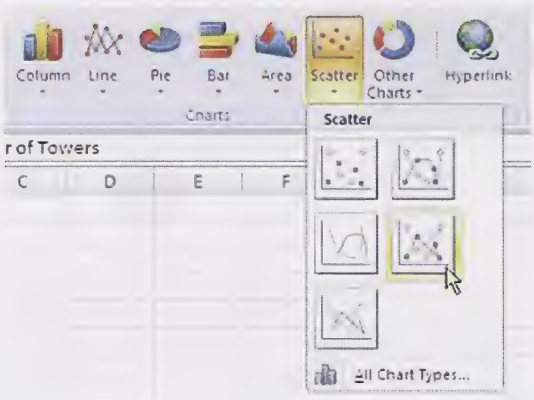
Are you looking for help on how to make a line graph? You can follow the steps below to create a line graph. You may want to print this out so you can have it beside you as you are making your graph.

Go to Excel. Type your information into Excel—you should have two vertical columns of data. Highlight the numbers and the headings.

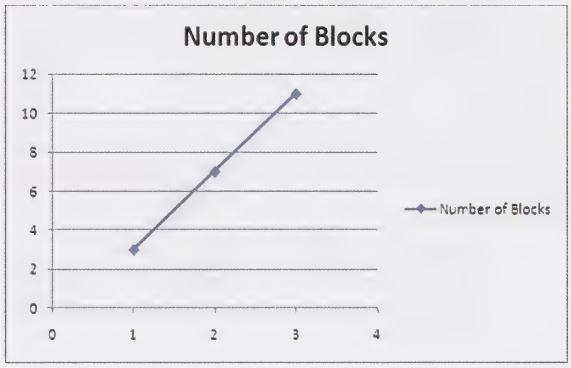


Click on the "Insert" tab on top toolbar.

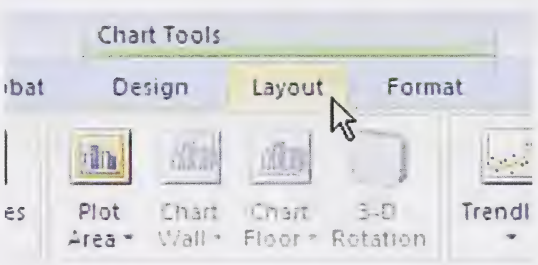
Choose "Scatter" if you want to make a line graph. (You can choose "Column" if you want a bar graph instead.)



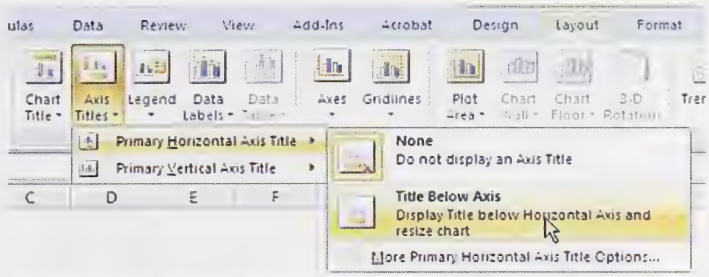
If you want a line, then click on the picture showing the straight line.



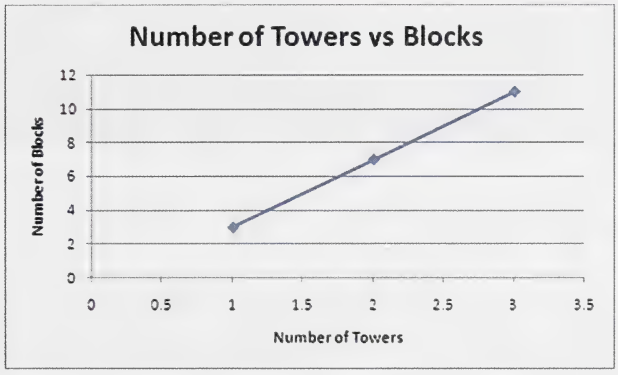
Now you can add a title to the graph, as well as titles to the axes. First, click on "Layout" in the top toolbar.



Second, choose the "Axis Titles" button to title the x axis and the y axis. Use the "Chart Title" button to give your graph a title.



You should now have a labelled graph.



You can now move your graph to wherever you want it.

Adam receives extra pay at his job for working overtime. The following table gives the information he has collected from his paychecks.

TT 2. Describe in words the relation between the overtime hours worked and the increase in pay.

TT 3. What variables would you choose to represent the overtime hours and the increase in pay?

TT 4. Draw a line graph to represent the relation between the overtime hours worked and the increase in pay. Label the axes with the variables you have chosen and the titles that describe what the numbers represent. Give your graph a title.

TT 5. Describe in words the relationship between the variables.

Overtime Work (h)	Extra Pay ($)
0.5	9
1	18
2	36
4	72
5	90

TT 6. Write an expression for the increase in pay in terms of the number of overtime hours worked.

TT 7. What would be the increase in pay for three overtime hours worked?

 Place a copy of your answers in your Math 8 course folder.

Discuss and Share

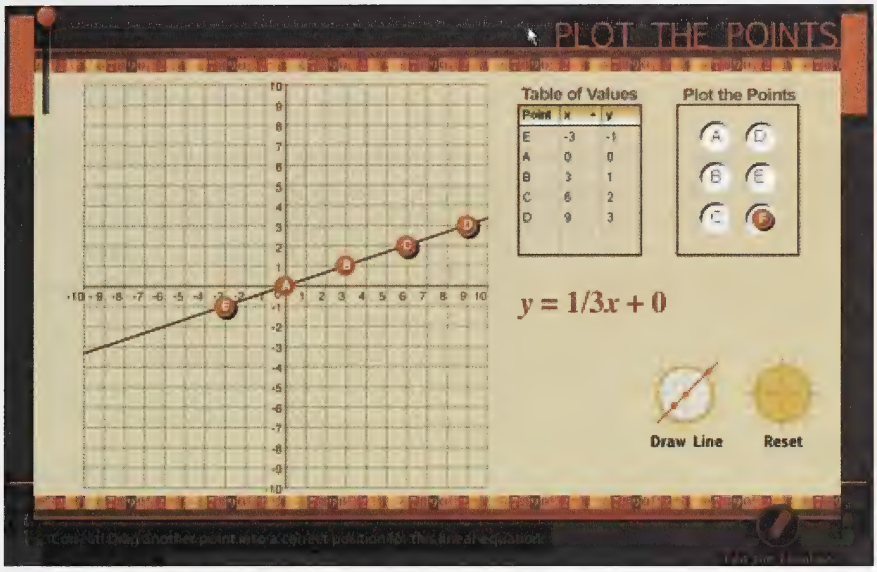
Create your own question about the increase in pay for overtime hours worked and post it to the discussion board along with your responses to the TT questions. Then respond to at least two questions posted by other students. Were their questions quite similar to yours?

Watch and Listen

Go to the Math 8 Multimedia DVD, and use the resource "Linear Equations" to create a table of values for a set of points that have been placed to represent a linear relation. So, place two points—Points A and B—close together on the grid and place a line through the points using the Draw Line button. Then place additional points on this line so that all the points are the same distance apart and are at the intersections of grid lines. (In this resource you can only place points where the grid lines intersect.)

Then study the Table of Values in the Window. If necessary, order the values of the table by clicking on the x variable in the header. Then confirm that when the differences between consecutive x values are the same, so are the differences between consecutive y values.

For example, the points A, B, C, D, and E are placed to represent a linear relation. The points give a Table of Values in which the difference between consecutive x values is 3 and the difference between consecutive y values is 1.



Read

Was it easy to tell the relationship between the **ordered pairs** from the table of values? To increase your ability to determine the relationship, study "Example 1: Identify the Relationship in a Table of Values" on page 344 of your textbook. See how they look at the differences in consecutive values in the table of values.

ordered pairs: the two values in order that are represented by a point on a graph or linked as corresponding numbers in a table of values

The first number is the value represented on the horizontal (x) axis, and the second number is the value represented on the vertical (y) axis. They are often written in brackets like (4, 7) or (8, –2) where they represent values of (x, y).

Self-Check

SC 1. Answer the "Show You Know" questions on page 344 of your textbook to practice what you have studied.

Compare your answers in the Appendix.

Read

You have improved your skills of identifying the relationship between ordered pairs in a table of values and graphing those values by studying "Example 1" and completing the "Show You Know" questions that followed. How are your skills of determining whether there is a linear relation? Get some more strategies to help you tell by studying "Example 2: Use a Table to Determine a Linear Relation" on page 345 of your textbook. "Literacy Link" in the margin of page 345 hints that graphing the values often helps.

Self-Check

SC 2. When you have finished the reading, answer the "Show You Know" on page 345 of your textbook to demonstrate to yourself that you have the skills mastered.

Compare your answers in the Appendix.

Read

Now that you have studied "Example 2" and completed the "Show You Know" that followed, you are ready to use your knowledge and skills to begin solving linear relations problems. Study "Example 3: Use a Table of Values in Solving a Problem" on page 346 of your textbook. This example is really important because it adds another step—formulating an expression to show the relationship between the variables. When you work through this example, please pay careful attention to steps c) and d), where the expression is developed and used.

The "Mental Math and Estimation" note in the margin of page 345 shows you how to quickly double-check your expression to see if it really matches the relation in the table. If the values do not match, you will have to change your expression until every value fits.

Self-Check

SC 3. Answer "Show You Know" on page 347 of your textbook.

Compare your answers in the Appendix.

Read

Study "Key Ideas" on page 347 of your textbook. Then transfer the important concepts you have gained to your first foldable for this unit. If you always remember to update your foldable, it will be a valuable study aid for your unit test!

Connect

Now that your skills of identifying linear relations from a table of values are stronger, how about applying them to the world around you? Put those skills to work by completing the following Self-Check questions.

Self-Check

SC 4. Complete "Communicate the Ideas" questions 1 and 3 on page 348 of your textbook.

SC 5. Complete "Check Your Understanding" questions 4, 6, 8, 10, 12, 14, and 16 on pages 348 through 350 of your textbook.

If you are having difficulty, discuss the questions with your partner or your teacher until you are sure you know how to do that type of question accurately. That's one of the skills of "learning how to learn."

Compare your answers in the Appendix.

Extra Practice

If you were able to accurately answer at least seven of the above questions, and you feel you have a solid understanding of how to build tables of values and interpret data, move on to the assignment. If you need a bit more practice with the concepts and ideas of this lesson, you may complete "Check Your Understanding" questions 5, 7, 9, 19, 13, 15, and 17 on pages 349 to 351 in your textbook. When you finish each question, check your work using the shortened answers given on pages 502 to 504 at the back of your textbook. Be sure to contact your teacher if you still have questions.

Assignment

Go to the Unit 6 Assignment Booklet and complete "Unit 6: Lesson 2 Question Set."

Try This

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TT 8. In preparation for your Unit 6 Problem, complete the "Math Link" questions found on page 351 of your textbook. This will give you an opportunity to practice some of the types of calculations and questions required for the unit problem. Notice how this trip is less expensive than some others and yet it allows the canoeists to appreciate the natural world without harming it.

Lesson Summary

In this lesson you learned to identify relationships in a table of values. You found that the relationship was linear if the difference in consecutive values was the same in every case for each of the variables. The differences did not have to be the same for both variables. For instance, the difference between consecutive values of variable x could be 1 in every case, and the difference between consecutive values of variable y could be 6 in every case, and the relationship would still be linear.

You also learned to represent a linear relation using a table of values, words, a graph, and an expression.

You saw that in making a graph, you should do the following:

- Each axis needs to be labelled with the variable represented.
- Each axis needs to given a word label.
- Units in which values are measured should be indicated.
- The graph itself needs to be given a title.

In this lesson you developed your ability to write an expression describing the linear relation depicted in a table of values. You even made tables of values from word problems and solved them using expressions derived from the data in those tables.

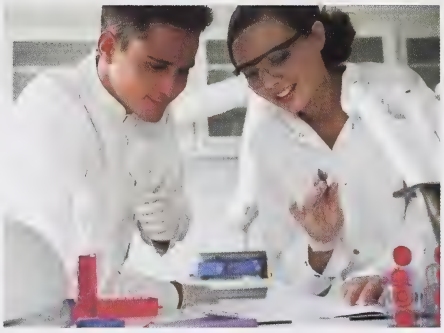
The skills that you learned in Lesson 2 will be extremely valuable to you in the lessons on linear relations that follow.

Unit 6: Linear Equations and Graphing

Lesson 3: Linear Relationships

Get Focused

When scientists collect data, how do they make sense of all their numbers? Well, they often put the numbers in a table and draw graphs of the data. Then they look for patterns, similar to what you have been doing. If they detect a pattern, they work to determine an expression that describes the relationship, just as you did in the last lesson. The expression is then put into an equation that can be used by other scientists, engineers, and technicians to answer further questions.



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In Lesson 2 you constructed graphs of linear relationships from tables of values. In this lesson you will build tables of values from formulas and equations. You will then draw graphs from these tables of values and solve problems using these graphs. The main emphasis in this lesson is to create accurate graphs from formulas and equations. By the end of this lesson, expect to solve problems using linear relationship graphs derived from equations.

This lesson will help you answer the following critical questions:

- How do you make a graph from the equation of a linear relation?
- How can you use the graph of a linear relation to solve a problem?

To complete the activities in this lesson you will need 1-cm grid paper, masking tape, cardboard tubes, and a measuring tape or metre-stick. Remember to access "1-cm Grid Paper" on the Math 8 Multimedia DVD when you need it.

Assignments

Your assessment will consist of the following:

- posting and responding to the discussion board
- adding to your Math 8 course folder
- completing Unit 6: Lesson 3 Question Set

Explore

Have you ever considered being part of a musical group and selling records to make a profit? Equations and mathematics will help you make good decisions regarding making money as well as making music.

Watch and Listen

To see how algebra can help a DJ with budgeting and planning expenses, go to the Math 8 Multimedia DVD and work through "Exploring Algebra." After you have watched the video, obtain a copy of the activity sheets. Use your mouse to choose the "Word" or "PDF" button to the left of the video under "Print Activities." Choose "Word" if your computer is a PC and "PDF" if you are using a Mac system. If you are submitting materials on paper, print out the exercise. If you want to answer the questions digitally, save a copy of the file to your computer. Use a different coloured font so your teacher can clearly find your answers, and insert your answers directly into the document.

Try This

TT 1. Once you have a copy of the Algebra Print Activity, do the following:

- Click "Interactive" to calculate the profit of certain record sales using hypothetical numbers. Answer questions 1 to 5 on the Algebra Print Activity sheet as you work through the interactive program. You must click in the spaces before you can insert a number.
- Once you are done questions 1 to 5, click "New" and work through the activity again to determine the profit using another set of record sales.
- Continue the cycle until you have a good understanding of the process.
- Discuss and share your answers with a partner.

TT 2. Answer questions 6 to 8 on the Algebra Print Activity sheets. Each question is about a different set of record sales. Answer the questions fully so you can comfortably share your work.

TT 3. Using your newly acquired knowledge of record sales, solve the following questions.

a. A DJ sells a number of records for $9 each. The equipment costs $300, and it costs $6 to produce each record. How many records must the DJ sell to break even (show exactly $0 profit)?

b. What will the DJ's profit be if 500 records are sold?

c. What are three potential ways the DJ can increase profits?


Place a copy of your answers in your Math 8 course folder.

Discuss and Share

Post your responses to TT 2 and TT 3 on the discussion board. Respond to two other students' postings, especially those explaining how they arrived at the answer to TT 3.a.

Read

If you make a table of values of the number of records sold and the profit made on each number of records sold, you can make a graph to predict the profits on any number of records sold by the DJ. You will be able to see where the graph crosses the horizontal axis (number of records sold), which shows a zero profit. Any more records sold, the graph will show a positive profit.

Knowing how many records you will need to sell in order to break even would be an important thing if you were the DJ, don't you think?

formula: a mathematical statement representing the relationship between specific quantities

To increase your ability to make tables of values from formulas and equations, study "Example 1: Graph from a Linear Formula" on pages 353 and 354 of your textbook. Pay special attention to "Literacy Link" in the margin on page 353. A **formula**, like $C = 2\pi r$, is a mathematical statement that represents the relationship between specific quantities. In this case, the formula represents the relationship between the circumference of a circle and the radius of a circle. Knowing the definition of *formula* will help you understand "Example 1" and others throughout this unit.

Self-Check

SC 1. Complete "Show You Know" on page 354 of your textbook.

Compare your answers in the Appendix.

Read

In "Example 1" and the previous activity, you chose numbers to put into a formula in order to build a table of values and then to draw and correctly label a graph. What about drawing a graph from a linear **equation** using integers?

equation: a mathematical statement with two expressions that have the same value

Study "Example 2: Graph From a Linear Equation Using Integers" on page 355 of your textbook to see how both positive and negative numbers can be put into an equation to build a table of values. Pay special attention to "Literacy Link" in the margin.

Note how an integer value is substituted into the equation for one of the variables. Substitution can be an effective strategy in solving problems.

Self-Check

SC 2. Complete "Show You Know" on page 355 of your textbook.

Compare your answers in the Appendix.

Read

Study the Key Ideas on page 356 of your textbook. Then continue building your handy study guide by transferring the important concepts you have gained to your foldable.

Self-Check

SC 3. Complete questions 1, 2, and 3 of "Communicate the Ideas" on page 356 of your textbook.

Compare your answers in the Appendix.

Connect

Now that you have built tables of values from formulas and equations and have drawn their corresponding graphs, it's time to apply your knowledge to real-world problems.

Self-Check

SC 4. Complete questions 5, 7, 9, 11, 14, and 17 of "Check Your Understanding" on pages 357 to 359 of your textbook. Then check your work using the answers given on pages 504 and 505 of your textbook.

If you are having difficulty getting any of the answers, discuss them with a partner or with your teacher. Knowing how to get the help you need and from whom to get it is one of the skills of "learning how to learn."

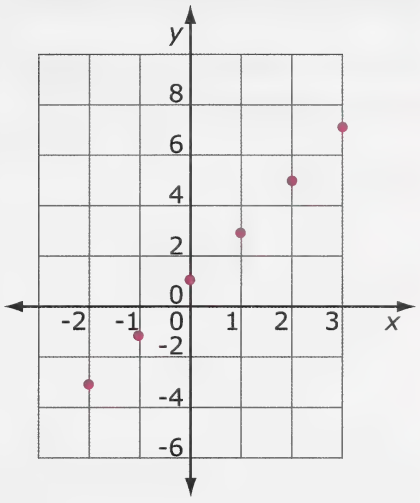
Extra Practice

If you need a bit more practice with the concepts and ideas of this lesson, complete questions 6, 8, 10, 12, 13, 15, 16, and 18 of "Check Your Understanding" on pages 357 to 359 of your textbook. Check your work using the answers given on pages 504 and 505 of your textbook. The sooner you realize whether or not you did it right, the easier it is for your brain to learn the concept. If you are still having trouble with the concepts in the lesson, be sure to contact your teacher for additional help.

Assignment

Go to the Unit 6 Assignment Booklet and complete "Unit 6: Lesson 3 Question Set"

Lesson Summary



In this lesson you drew graphs from formulas. The first step was to substitute numbers into the formula to make the table of values. There are often distinct advantages in choosing zero as one of the numbers in your table of values. For example, it makes the calculation easy to do, and it gives you an easy starting point for when you are drawing the graph. You were also advised to choose numbers for the horizontal axis that were small enough to easily draw the graph.

You used integers with both negative and positive values in some of the equations. Then tables of values were developed for these integers. The graphs for these relationships were then designed so that both negative and positive values could be represented on the axes (as shown in the graph).

In this lesson you were able to answer whether values in between those depicted were appropriate. The answers to those questions depended on the specific situation for which the graph was drawn. You were also able to answer questions about values not shown on the graph by interpreting the graph and the table of values. Then you were able to check your answers by substituting the appropriate numbers into the equations and formulas to see if the results matched.

In the lessons that follow you will improve your skills of working with linear equations even more.

Unit 6: Linear Equations and Graphing

Lesson 4: Modelling and Solving One-Step Multiplication and Division Equations

Get Focused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How would you feel about going on a whale-watching vacation? This could be a good selection for your Unit 6 Problem. There are a variety of places and types of holidays to choose from.

- You could take orca-watching day excursions for around $95 per day in British Columbia. Another choice in B.C. would be a seven-day cruise along Vancouver Island for $3794.
- You could enjoy a five-day sea-kayaking adventure and watch California gray whales in Baja, Mexico, for $895.
- If you chose whale watching in the Canadian Arctic, Qikiqtarjuaq on Baffin Island in Nunavut would be great because you could see as many as seven different types of whales swimming in Davis Strait. The hotel there costs $225 per night.
- Hawaii, Australia, and the Caribbean offer other whale watching opportunities.

When vacationers plan holidays, the cost of the trip is almost always considered. Rates are given in a variety of ways; for example, per day, per person, per couple, or per package.

Rates are not always given in Canadian dollars either. Converting back and forth between these rates for comparison shopping and to determine the total expected cost of the trip can be done using one-step multiplication and division equations. This lesson will help you understand how to model these equations and to solve problems involving the equations. By the end of this lesson, expect your skill at solving one-step multiplication and division equation problems to be noticeably stronger.

This lesson will help you answer the following critical question: How can you use models and symbols to solve and verify an equation?

You will need 1-cm grid paper for this lesson—remember "1-cm Grid Paper" is available on the Math 8 Multimedia DVD. You will also need a sheet of 11 by 17 paper, scissors, a stapler, and a ruler to make a foldable like the one described on page 368 of your textbook. As an alternative, you can make a foldable by taping two 8½ by 11 sheets together along the longer sides.

Assignments

Your assessment will consist of the following:

- posting and responding to the discussion board
- adding to your Math 8 folder
- completing Unit 6: Lesson 4 Question Set

Explore

In Lesson 3 you read about scientists drawing graphs to make sense of experimental data. Begin by reading about Simone's experiment on page 370 of the textbook.

In the following activity you will draw a graph of Simone's data and develop a **linear equation** to describe the relationship. The linear equation you will develop is named after the scientist Robert Hooke, who first discovered and wrote about the relationship between force and the stretching of a spring.

linear equation: an equation, the graph of which has points that lie in a straight line
Examples are $y = 3x$, $p = \frac{r}{4}$, and $k = 5 + 7d$.

Try This

TT 1. How do you feel about using your brain like a scientist? Complete "Explore the Math" questions 1, 2, 3, 4, 5, and 6 on pages 370 and 371 of your textbook. Go to the Math 8 Multimedia DVD to download 1-cm grid paper. Be sure to study the thought clouds that go with each question. Each cloud provides hints to help you answer the questions.

Place a copy of your answers in your Math 8 course folder.

You may need to make a new foldable to record the important ideas found in this lesson. Construct the new foldable using the directions on page 368 of the textbook. Then add the definition for *linear equation* from the margin on page 371 to your foldable. Also add notes about **coefficient** and **constant**, which are found in the "Literacy Link" on page 371. The coefficient is the number in front of a variable by which the variable will be multiplied. A constant is a number in an equation that does not change.

coefficient: a number or quantity put with and multiplying another quantity
Example: In $y = 3x$, 3 is the numerical coefficient of x.

constant: a number in an equation that does not change
Example: In the equation $y = x + 4$, the constant is 4.

Try This

To demonstrate your understanding, complete the following Try This questions. Work with a partner on these questions if you can by discussing how to mentally figure them out and by working out the answers in your heads.

TT 2. What force would Simone need to stretch the spring 40 cm?

TT 3. What force would Simone need to stretch the spring 12 cm?

TT 4. If Simone used 15 newtons of force, how much would the spring stretch?

TT 5. If Simone used 75 newtons of force, how much would the spring stretch?

TT 6. If Simone used –24 newtons of force, how much would the spring compress?

TT 7. Use a graph to estimate the amount the spring would stretch if Simone used 44 newtons of force. Then calculate your answer using the equation. How close are the two answers?

Discuss and Share

Summarize your understanding of how equations are developed from a table of values and the corresponding graph. Post your summary, along with your responses to the Try This questions, onto the discussion board. Respond to two of the postings from other students. Comment on the summaries.

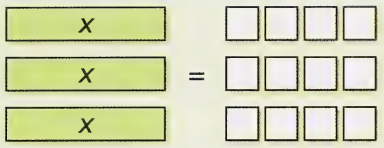
Finally, adjust your answers, if necessary, from any responses that you received. Then put your expanded summary in your course folder.

Read

There are several correct methods of solving equations. Have a look at three methods by studying "Example 1: Solve an Equation" on pages 371 and 372 of your textbook. See how the first method demonstrates how to solve by inspection.

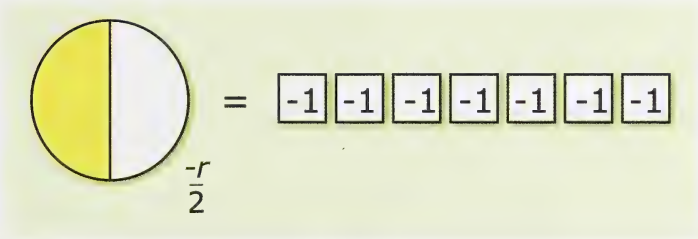
Notice that the thought clouds are questions to ask yourself so that you can solve the equation by inspection. Each problem has an alternate question or way of thinking to arrive at the answer, whether you want to look at it as a multiplication question or a division question.

In method 2, shown on page 372, the problem can be modelled with algebra tiles.



Because the equation is $3x = -12$, three green variable tiles are placed on the left side. Then 12 negative (white) tiles are arranged into three equal groups on the right side. Can you see that each green variable x must equal four white tiles (–4)? Notice how the solution $x = -4$ is placed back into the equation to check the work. Do you see that each side of the equation is worked separately? Then both sides are checked. Both sides must be equal. If both sides are not equal, then the solution is not correct.

The third method solves the equation $\frac{r}{-2} = -7$ using diagrams.



Notice that when the left side is doubled to get a whole diagram, the number of squares also on the right is also doubled. What you do to one side of an equation, you must do to the other. Here the "thought clouds" show you how to deal with negative numbers on the variable side. In the first case, you make the variable negative so the 2 on the bottom of the fraction is positive. In the second case, you multiply both sides of the equation by –1 to make the variable positive again.

Self-Check

SC 1. When you have finished studying "Example 1," answer "Show You Know" on the top of page 373 in your textbook. There may be several good ways to arrive at the answer. If you are unsure of a method to find the unit rate, discuss it with your partner or ask your teacher about it.

Compare your answers in the Appendix.

Another method of solving multiply equations like $-84 = 12d$ is to apply the **opposite operation**.

opposite operation: an action which undoes another operation

Addition and subtraction is an example of opposite operation. So is multiplication and division.

The equation tells us to multiply the variable by 12.

$-84 = 12 \times d$

So to apply the opposite operation means divide both sides of the equation by 12.

$$\frac{-84}{12} = \frac{12d}{12}$$

$-7 = d$

Read

See how this operation is done by reading "Example 2: Divide to Apply the Opposite Operation" on page 373 of your textbook. Note how the two "Literacy Links" in the margin on page 373 give you greater understanding of some of the words and phrases used in describing strategies for solving equations. Don't you think they should go into your new foldable?

Self-Check

SC 2. Answer the "Show You Know" on the bottom of page 373 of your textbook. If you are having difficulties with a question, discuss your challenges with a partner, if you can, or with your teacher.

Compare your answers in the Appendix.

Read

What about using the opposite operation to solve division equations like $\frac{t}{3} = -8$? The equation tells us to divide the variable by 3. So applying the opposite operation in this case means to multiply both side of the equation by 3. See how this is done by reading "Example 3: Multiply to Apply the Opposite Operation" on page 374 of your textbook. The problem is stated in words, and the equation has to be constructed from the information provided. Note how "Literacy Link" in the margin on page 374 reminds you of three ways in which division is indicated. You may wish to add this information to your foldable.

Self-Check

SC 3. Answer "Show You Know" on the bottom of page 374 of your textbook so you have the opportunity to practice this skill.

Compare your answers in the Appendix.

Read

Read "Key Ideas" on page 375 of your textbook. Put the important ideas from this lesson into your foldable.

Connect

Now that you are able to use three methods to solve equations, apply these techniques to some other situations. Complete the following Self-Check questions to increase your skills at writing and solving equations using these methods.

Self-Check

SC 4. Complete "Communicate the Ideas" questions 1, 3, and 4 on page 376 of the textbook.

SC 5. Complete "Check Your Understanding" questions 5.a), 5.b), 7, 8, 10, 11, 13, 15, 19, 22, and 24 on pages 376 through 378 of the textbook. Refer back to the examples if you need a reminder as you are completing them.

Compare your answers in the Appendix.

If you can't figure out a question, be sure to ask your teacher about it.

Extra Practice

If you were able to answer at least nine of the SC 4 and SC 5 questions accurately, then you are ready to go on to the Question Set.

If you believe you need a bit more practice, complete questions 5.c), 5.d), 6, 9, 12, 14, 16, 17, 20, 21, and 23 from "Check Your Understanding" on pages 376 through 378 in the textbook. When you finish each question, check your work using the answers given on page 507 at the back of your textbook. Knowing quickly whether or not you answered questions accurately helps you learn faster. Be sure to ask your teacher about a question if it is giving you difficulty.

Assignment

Go to the Unit 6 Assignment Booklet and complete "Unit 6: Lesson 4 Question Set."

Going Beyond

Would you like to know how to encrypt a message in secret code so only those who had the key could understand what it meant? Learn how to encrypt a password reading "Math Link" on page 369 of the textbook. This passage shows a simple way to encrypt messages using equations. Send the encrypted message "Here is my challenge to you" to the discussion board to see if others can figure out the equation you used. Try to figure out the encryption codes used by other students, and send them a short reply.

Lesson Summary

In this lesson you learned several ways to solve one-step multiplication and division equations involving integers. In each method, what was done on one side of the equal sign was done on the other side also, so that each equation remained with one side equal to the other. You discovered four methods for solving equations:

- Solve by inspection. In this method you learned to ask yourself questions about the equation. For a multiplication equation, such as $4y = -20$ you would ask yourself, "What number multiplied by 4 equals –20?" The solution is –5.

- Model the equation using concrete materials, such as algebra tiles. Arrange the materials so there is a consistent pattern on both sides of the equal sign to find the solution.

- Use diagrams to model the equation. Multiply the diagrams on both sides of the equal sign by an appropriate number to get one diagram of the variable isolated.

- Perform the opposite operation on both sides of the equal sign. In this method, if the equation said to multiply the variable by a certain number, you divided both sides by that number. If the equation said to divide the variable by a certain number, you multiplied both sides by that number.

In this lesson you also learned to check your solution to see if it was accurate. You could check it by modelling the solution with concrete materials, such as algebra tiles. You could also check it by substituting the solution into the equation and seeing if both sides of the equation had the same value.

The concepts and strategies to solve one-step equations that you have learned in this lesson will be used along with other strategies in the next lesson to solve two-step equations.

Unit 6: Linear Equations and Graphing

Lesson 5: Modelling and Solving Two-Step Multiplication Equations

Get Focused

Ecotourism is a trendy way to spend your vacation. Travelling to an exotic location—like Uganda, Africa—to observe wildlife in its natural habitat has really caught the interest of many people. True ecotourism has a low impact on the environment, includes an educational feature for the tourists, and is designed to benefit the local communities. Some of the costs of an ecotourism vacation even go toward funding local conservation efforts.

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An ecotourism vacation to see the gorilla (and other African wildlife) costs around $2650 for airfare and about $350 per day for all other expenses (e.g., food, accommodation, fees, guides, and transportation). A two-step equation that will calculate the cost for varying numbers of days is $C = 350n + 2650$. How many days would a trip take that cost $6500?

In this lesson you will model problems involving two-step equations like the one representing the vacation to see the gorilla. You will discover how to solve these equations and to check your solutions for accuracy.

This lesson will help you answer the following critical question: How do you solve an equation that is in the form $ax + b = c$? (In the $ax + b = c$ equations that you are solving a, b, and c will all be numbers, which are also referred to as constants.)

In this lesson you will need your algebra tiles.

Assignments

Your assessment will consist of the following:

- posting and responding to the discussion board
- adding to your Math 8 folder
- completing Unit 6: Lesson 5 Question Set

Explore

In the days before electronic scales and spring balances, merchants and scientists measured the mass of an object by putting them on one pan of a balance like the one in the picture. These merchants and scientists would then add known masses to the other pan until the two pans sat at the same height—the needle in the middle would be pointing straight up. At that point, the mass on one side is exactly equal to the mass on the other. A person could determine the mass of the first object by totaling the known masses.

What about using a pan balance to model equations?

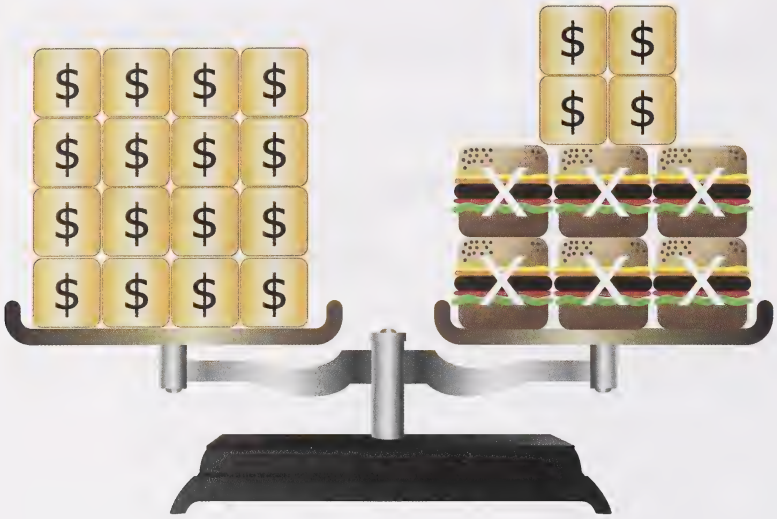
Try This

TT 1. When David and some friends went to a restaurant for lunch, they ordered six burgers and one supersized fries. Their purchase can be modelled by the equation $C = 6x + f$, where C is the cost of their order before taxes, x is the cost of a burger, and f is the cost of the fries. If the fries cost \$4 and their total bill is \$16, what is the cost of a burger?

Use a model to solve the equation and answer the question. You will need to first substitute the known amounts, $C = 16$ and $f = 4$, into the equation.

$$C = 6x + f$$
$$16 = 6x + 4$$

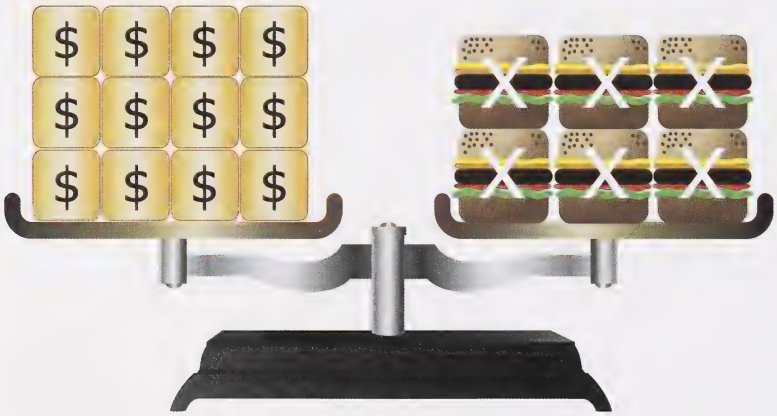
A model of the equation using a pan balance and blocks looks as follows.



a. To get the burgers (x blocks) by themselves, how many dollar blocks must you subtract from the right side?

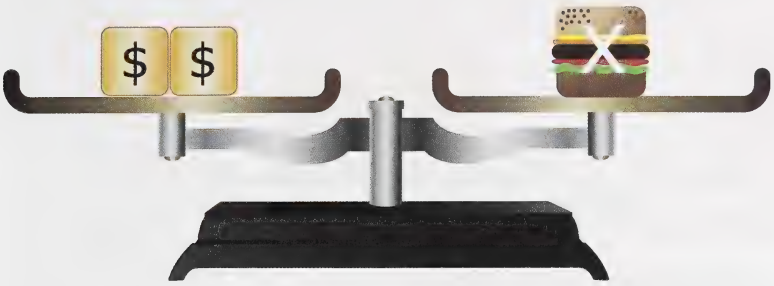
b. Now, what must you do to the left side?

The model will then look like this:



c. Now that the x-blocks are by themselves, what number must you divide both sides by to get one x-block isolated?

After you have divided by that number, the balance will look like this:



d. What is the value of x? Check the solution to insure that it is accurate.

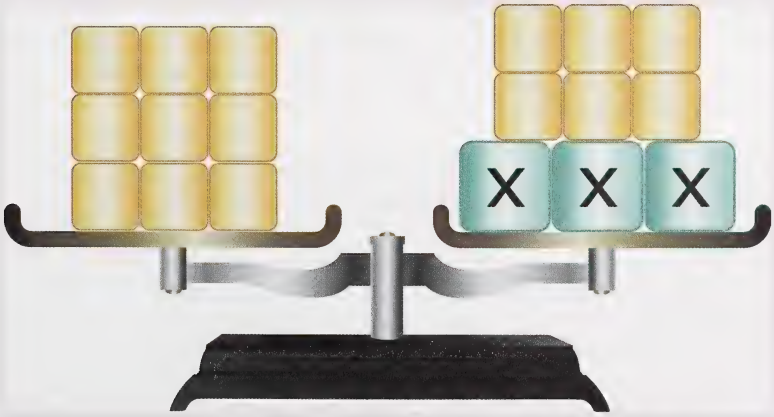
e. What is the cost of a burger?

My Guide

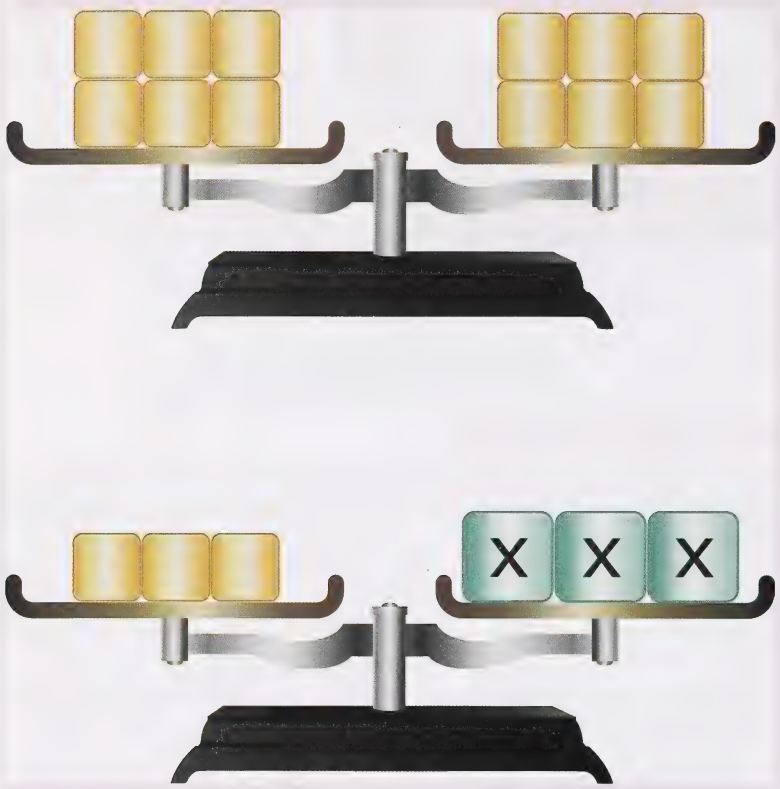
Q: Do you see how each part of the equation is represented by the coloured blocks on the pan balance? The equal sign in the equation is the triangle balance point of the diagram. How can you use the strategies of solving equations covered in Lesson 4 to solve equations using models?

A: Recall from Lesson 4 that the strategy of solving equations is to isolate the variable, where you get the unknown quantity—the variable—all by itself on one side of the equation. When doing this, whatever you do to one side of the equation must be done to the other side. The same goes when using a model. Whatever you do to one side of the balance, you must do to the other side.

Q: What must you do to the following to isolate the x-blocks and keep the scale balanced?



A: To isolate the 3 x-blocks on one side of the scale and keep the scale balanced, you must take away 6 yellow blocks from both sides of the scale.

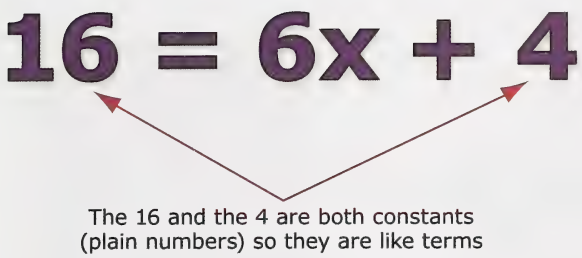


Read

Did modelling the equation with a two-pan balance help you understand how to solve this type of equation? Did you see how the number blocks and the x-blocks were different (different size and colour)? This is important to note because when you add or subtract numbers, you will need to make sure you always add or subtract **like terms**.

like terms: terms in an expression or equation that are the same type of quantity

For example, in the equation $16 = 6x + 4$, the numbers 16 and 4 are like terms. They are plain numbers and can be added to or subtracted from each other. The term $6x$ includes a variable and so is not a like term with 16 and 4.



Study "Example 1: Model With a Balance Scale" on pages 380 and 381 of your textbook. Note how the example isolates the variable by subtracting the same number from both sides. Also note how to check the solution—keeping the left and right side of the equation separate, as covered in Lesson 4.

Self-Check

SC 1. Complete "Show You Know" on page 381 of your textbook.

Compare your answers in the Appendix.

Read

Now that you have improved your skills at modelling equations using a pan balance, it is time to use these skills to model and solve equations using algebra tiles.

Start by working through "Example 2: Model With Algebra Tiles" on page 382 of your textbook. Each white square represents −1, and each red square represents +1. Again, note how the example checks the solution—keeping the left and right side separate. Pay special attention to the "Literacy Links" in the margin. They provide valuable information that should be placed into your current foldable.

Memorize the correct **order of operations**, if you don't already know it by heart. With these equations, start on the left of the expression or equation and do any multiplication or division you encounter going from left to right. Do division before multiplication if you encounter division first. Next, start on the left of the expression and, again, do any addition or subtraction you encounter going from left to right. Do subtraction before addition if you encounter it first.

order of operations: the correct sequence of steps in calculating a mathematical expression

The following is the correct sequence of steps:

- First, do all calculations in brackets.
- Second, multiply and divide in order from left to right.
- Third, add and subtract in order from left to right.

Self-Check

SC 2. Complete "Show You Know" on page 382 of your textbook.

Compare your answers in the Appendix.

Read

You have now improved your skills at modelling equations using algebra tiles. Now, you are ready to solve equations by applying the opposite operation using just symbols, similar to what you did in Lesson 4. However, this time you will be performing an additional addition or subtraction step to isolate the variable.

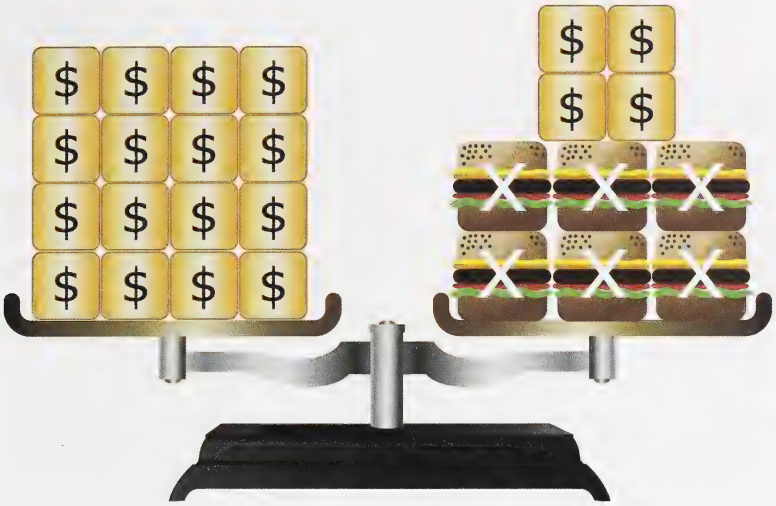
Study "Example 3: Apply the Opposite Operations" on page 383 of your textbook. Notice that the left side of the equation is adding 3 to $4w$. So, you need to subtract (the opposite of add) both sides by 3 to isolate $4w$ and keep the equation balanced. Also note that the solution in "Example 3" is checked using algebra tiles.

When solving equations, you will need to use the **reverse order of operations**, as defined in the "Literacy Link." For example, the reverse order for the equation in Example 3 means you must subtract first before dividing.

reverse order of operations: to isolate a variable, follow steps that are the reverse of the normal order of operations

When isolating a variable, add or subtract first; then multiply or divide.

Remember when you were solving the equation $16 = 6x + 4$ using the pan balance? The equation says to add 4 to the side with the variable x.



To isolate the variable, you subtracted four dollar squares from both sides, the opposite of what the equation said to do. This is an example of performing the opposite operation.

For your current foldable, write a note stating that you must follow the reverse order of operations when isolating a variable.

Try This

TT 2. Complete "Show You Know" on page 383 of your textbook. Make sure you check your work.

Discuss and Share

Post your answers to TT 2 on the discussion board. Then respond to at least two other postings. If you have questions about your answers or about other postings, please discuss them with your teacher.

Read

Study "Key Ideas" on page 384 of your textbook, and transfer the main ideas to your foldable. These foldables make great study guides and are definitely worth the effort to create.

Connect

Now that you have studied how to solve and check two-step equations, it's time to incorporate your new-found knowledge to slightly different situations by completing the Self-Check questions that follow.

Self-Check

SC 3. Complete questions 1 and 2 of "Communicate the Ideas" on page 384 of your textbook.

SC 4. Complete questions 3, 5, 7, 8, 9, 12, 14, and 16 of "Check Your Understanding" on pages 385 and 386 of your textbook.

SC 5. Complete "Math Link" on page 387 of your textbook.

Compare your answers in the Appendix.

Discuss and Share

Make up a question similar to those you have just answered, and post it on the discussion board. Then respond to at least two other postings.

If you are having difficulty understanding any answers in the preceding Self-Check questions, discuss them with a partner or your teacher.

Extra Practice

If you feel you have a solid understanding of how to model and solve two-step multiplication equations, go on to the assignment. If you need a bit more practice with the concepts, complete questions 4, 6, 10, 11, 13, 15, and 17 from "Check Your Understanding" on pages 385 and 386 of your textbook. Then check your work using the shortened answers given on pages 507 and 508 of your textbook. Contact your teacher if you are still having difficulties with the concepts.

Assignment

Go to the Unit 6 Assignment Booklet and complete "Unit 6: Lesson 5 Question Set."

Self-Check

SC 6. In preparation for your Unit 6 Problem, consider the question about the ecotourism vacation to Africa posed at the beginning of this lesson. In the equation given, $C = 350n + 2650$, the variable C is the total cost in Canadian dollars and n is the number of days on the vacation. The number 2650 is the airfare for a round-trip ticket from Alberta to Uganda.

a. How many days will the trip be if the cost is $6500?

b. If you were able to book a cheaper flight, how would the equation be affected?

c. If the daily cost went up by $30 because you needed a porter to carry extra camera equipment, how would the equation be affected?

Compare your answers in the Appendix.

Lesson Summary

In this lesson you modelled and solved problems involving two-step linear equations. One of the ways you modelled these problems and their equations was with blocks and a pan balance. In solving these problems, you isolated the variable first. To keep the pan balance level, what you do to one side you always do to the other.

A second way you modelled problems involving two-step linear equations and solved them was using algebra tiles.

As you did in the previous lesson, you checked your solution by substituting the solution into the equation to see if both sides of the equation had the same value. You could also check it by modelling the solution with concrete materials, such as algebra tiles. Checking your answer is a really important step. Don't skip this step!

In this lesson you also solved equations just using the symbols of mathematics and algebra. You learned to use the reverse order of operations when isolating the variable. This means that you added or subtracted first, being sure to perform the same operation on both sides of the equation. In this lesson you then divided both sides by the coefficient of the variable. In every case this yielded an accurate solution.

Equations solved using symbols can also be checked by substituting the solution into the equation using symbols or checked by the use of concrete materials, such as algebra tiles.

In Lesson 6 you will add to your skills of solving two-step equations by solving equations in which the variable is divided by a constant instead of multiplied by lesson constant.

Unit 6: Linear Equations and Graphing

Lesson 6: Modelling and Solving Two-Step Division Equations

Get Focused

Andrew and his friends have been saving for a spring-break snowboarding vacation to Whistler, B.C., the site of the 2010 Winter Olympics. They plan to reduce their expenses by renting a condo for a week and sharing the cost. The more friends who come with Andrew, the less each will have to pay. They found a special airfare and lift-pass rate that will give them each five days of snowboarding for $630. If four of them rent the condo for six nights, the total cost of the holiday, excluding food, would be $803. How much are they paying to rent the condo? How much less would it cost each person if they had six people staying together?

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A two-step linear equation that will calculate the rental cost for the condo for four people is $803 = \frac{r}{4} + 630$. Notice how this equation looks a little different than the equations you worked with in Lesson 5. Here the variable is divided by the constant 4 instead of being multiplied by a constant. This is the type of equation you will be modelling and solving in Lesson 6.

You can calculate the cost of the holiday for varying numbers of people using a more general form of the equation:

$$C = \frac{r}{n} + 630$$

In this form, C is the total cost per person, r is the condo rental fee, and n is the number of people staying in the condo.

In this lesson you will model problems involving two-step linear equations like the one shown above. You will also learn how to solve these equations and to check your solutions for accuracy.

This lesson will help you answer the following critical question: How do you solve an equation that is in the form $\frac{x}{a} + b = c$?

Assignments

Your assessment will consist of the following:

- posting and responding to the discussion board
- adding to your Math 8 folder
- completing Unit 6: Lesson 6 Question Set

Explore

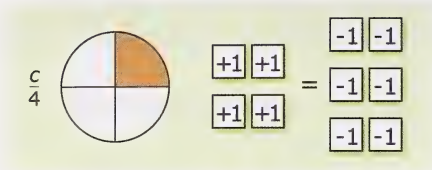
Persian cats are noted for their long hair and soft, flowing coats. Border collies are medium-sized dogs that are bred to be good herders and generally have excellent instincts when working with sheep and cattle. The average masses of the Persian cat and the border collie are described on page 388 of the textbook. Can you describe the relationship between their average masses through an equation?

A Persian cat has long hair.

Try This

TT 1. Complete "Explore the Math" questions 1, 2, 3, and 4 on page 388 of your textbook. Working with a partner in this activity will help you learn these math concepts. Your partner should be someone you can talk to about the activity as you answer the questions and not just someone to check your work.

To demonstrate your understanding of the process in solving this type of equation, complete the following Try This questions about the diagram below. Work with a partner on these, if you can, by discussing how to figure them out.



TT 2. What equation is represented by the diagram?

TT 3. What is the first step in solving the equation?

TT 4. Describe the diagram, and state the equation that would result from completing the first step.

TT 5. What is the second step in solving the equation?

TT 6. What is the value of *c*?

TT 7. How can you check or verify your solution?


Place a copy of your answers in your Math 8 course folder.

Discuss and Share

Make up a rule that explains how to solve this type of equation, and post your rule onto the discussion board. Then respond to postings by two other students. Comment on the rule described in the postings. If the rule is accurate, acknowledge how the rule for finding a solution may be different from yours and yet still be accurate.

Read

Did you find this type of equation easier or harder to understand and solve than the equations you worked on in the previous lesson? To increase your ability to model this type of equation, study "Example 1: Model Equations" on page 389 of the textbook. See how the textbook first begins to isolate the variable by adding the same number to both sides. Then the textbook says, "Multiply by 2 to fill the circle." That also eliminates the fraction and gives you the variable isolated on one side of the equation. The textbook also checks the solution, keeping the left side and right side of the equation separate, like you learned to do in Lessons 4 and 5.

Self-Check

SC 1. Answer the "Show You Know" on page 389 of the textbook.

Compare your answers in the Appendix.

Read

You have improved your skills at modelling equations using drawings. How about just applying the reverse order of operations and solving equations that way? Study "Example 2: Apply the Reverse Order of Operations" on page 390 of your textbook. The thought clouds are there to guide your thinking as you read through "Example 2."

Self-Check

SC 2. Answer the "Show You Know" on page 390 of your textbook.

Compare your answers in the Appendix.

Read

Carefully study "Key Ideas" on page 391, and then transfer the main ideas to your foldable.

Connect

Now that you have studied how to solve and check two-step multiplication equations, put those skills to work by completing the following Self-Check questions.

Self-Check

SC 3. Complete "Communicate the Ideas" questions 2 and 3 on page 391 of the textbook.

SC 4. Complete "Check Your Understanding" questions 4, 6, 8, 9, 10, 14, and 16 on pages 392 and 393 of the textbook.

SC 5. Complete the "Math Link" questions on page 393 of the textbook.

You will also find more complete solutions to questions 4 and 10 a) and b) on that link.

Compare your answers in the Appendix.

Extra Practice

If you were able to accurately answer at least seven of the Self-Check questions, and you feel you have a solid understanding of how to model and solve two-step division equations, go on to the assignment.

If you need a bit more practice with the concepts and ideas of this lesson, you may want to complete "Check Your Understanding" questions 5, 7, 11, 12, 13, and 15 on pages 392 and 393 of your textbook. When you finish each question, check your work using the shortened answers on page 508 at the back of your textbook. The quicker you get feedback on your answers, the faster you learn. Make sure to contact your teacher if you still have questions after completing this additional practice.

Assignment

Go to the Unit 6 Assignment Booklet and complete "Unit 6: Lesson 6 Question Set."

Going Beyond

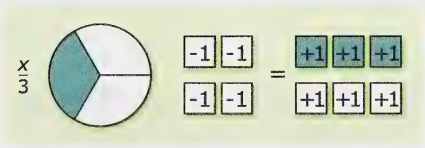
Most people who go on an adventure vacation want to be in the best physical shape possible. How many calories per day should a person consume to stay in top form? It depends partly on a person's activity level and gender. There are equations to help you figure out the number of calories that are required.

Have a look at how these equations work by completing "Check Your Understanding" question 17 on page 393 of your textbook.

Compare your answers in the Appendix.

Lesson Summary

In this lesson you modelled and solved problems involving two-step linear equations in the form $\frac{x}{a} + b = c$. You modelled these problems and their equations with diagrams, similar to the following.



This diagram models the equation $\frac{x}{3} - 4 = 6$.

You worked to isolate the variable, and what you did to one side you always did to the other. You do the reverse order of operations, which means you add or subtract first, then you multiply or divide. To isolate the variable x, you apply the opposite operation. The equation says to subtract 4, so you add 4 to each side.

$$\frac{x}{3} - 4 + 4 = 6 + 4$$
$$\frac{x}{3} = 10$$

The equation says to divide the variable x by 3, so you multiply both sides by 3.

$$\frac{x}{3} \times 3 = 10 \times 3$$
$$x = 30$$

The solution to the equation is $x = 30$.

As you did in the previous lessons, you checked your solution by substituting the solution into the equation, to see if both sides of the equation had the same value.

Check:

$$\text{Left Side} = \frac{x}{3} - 4 \qquad \text{Right Side} = 6$$
$$= \frac{30}{3} - 4$$
$$= 10 - 4$$
$$= 6$$

Left Side = Right Side

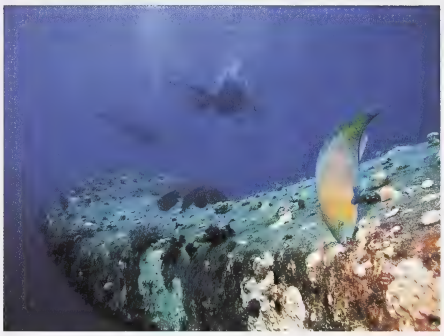
The solution is correct because both sides are equal in value.

Lesson 7 will also involve two-step equations. In that lesson, however, the variable in the equation will be inside brackets, so you will get to use the distributive property.

Unit 6: Linear Equations and Graphing

Lesson 7: Modelling and Solving Two-Step Distributive Property Equations

Get Focused



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Rebecca and Navi would love to go scuba diving in the Caribbean. The water is warm and clear, and the fish are spectacular. They would like to explore some of the sunken wrecks that dot the island waterways. In preparation for their holiday, they have taken lessons and are certified divers.

An equation that describes their scuba diving package and hotel expense is $n(x+70)=C$. The variable n is the number of days they will stay, x is the cost of the hotel, 70 is the cost of two scuba dives per day, and C is the total cost of the package. Since some hotels are more expensive than others, Rebecca and Navi must make choices about their vacation. They need to decide whether to have a longer vacation but choose less expensive hotels or enjoy the luxury of a fine hotel but have a shorter vacation. The equation helps them calculate costs for different lengths of vacation and different hotel prices.

If Rebecca and Navi have budgeted $1440 for their package and plan six days of diving, how much can they afford to spend a night for a hotel? The two-step equation that will calculate the nightly cost for the hotel is $6(x+70)=1400$.

The equation that Rebecca and Navi use looks a little different than the other equations you have encountered in this unit, because the variable is inside a bracket. This equation is also linear, however, because the pattern of the graph of values from the equation gives a straight line as you would expect linear equations to do.

In this lesson you will model problems involving two-step linear equations. You will also learn how to solve these equations and to check your solutions for accuracy. Accuracy means your numbers are correct so that you get what you want for the price you are able to pay.

This lesson will help you answer the following critical question: How do you solve an equation that is in the form of $a(x + b) = c$?

To complete the activities in this lesson you will need algebra tiles or something that can substitute for tiles, such as coloured paper squares and rectangles.

Assignments

Your assessment will consist of the following:

- posting and responding to the discussion board
- adding to your Math 8 folder
- completing Unit 6: Lesson 7 Question Set

Explore

Two-step equations with brackets, like the ones shown in the Get Focused section, can be solved using algebra tiles.

Try This

TT 1. Try answering some two-step equations by completing "Explore the Math" questions 1, 2, 3, 4, and 5 on page 394 of your textbook. If you cannot obtain algebra tiles, you can make tiles from white and coloured paper or construction paper. You will need 21 white squares, 30 red squares, and 3 green x-rectangles for this activity. Working with a partner in this activity will help you learn these math concepts.

You will use the following diagram to complete TT 2, TT 3, TT 4, TT 5, TT 6, TT 7, and TT 8. Remember, the red squares represent positive 1-tiles. Work with a partner on these if you can by discussing how to figure them out.

TT 2. How many sets of $x + 5$ are represented by the algebra tiles?

TT 3. What equation of the form $a(x + b) = c$ is represented by the algebra tiles? (Fill in the numbers for a, b, and c.)

TT 4. How many positive 1-tiles (i.e., red tiles) will you subtract from both sides of the diagram as the first step in solving the equation?

TT 5. State the equation that would result from completing the first step.

TT 6. What is the second step in solving the equation?

TT 7. What is the value of x?

TT 8. How can you check or verify your solution?

 Place a copy of your answers in your Math 8 course folder.

Discuss and Share

Develop a rule for solving this type of equation, and post it onto the discussion board, along with your responses to the Try This questions. Then respond to two of the postings from other students by stating whether their rules and their ways of arriving at the solution to the equations were basically the same or different from your rule. Could the other rules still be accurate?

Read

Did you find this type of equation, $a(x + b) = c$, easier or harder to understand and solve than the types in the previous lesson? To increase your ability to model this type of equation, study "Example 1: Model With Algebra Tiles" on page 395 of your textbook.

See how the textbook demonstrates a model of the equation with algebra tiles. As in previous lessons, the first step is to isolate the variable by the following:

- Subtract the same number—in this case, 8—from both sides. The thought cloud in the middle of page 395 reminds you that subtracting 8 positive 1-tiles or red tiles is the same as adding 8 negative 1-tiles or white tiles.

- Divide both sides by the same number, 4, because there are 4 x-tiles. That gives you the solution because the variable x is now isolated on one side of the equation.

- The solution is checked, keeping the left side and right side of the equation separate, like you learned to do in Lessons 4 and 5.

The "Literacy Link" at the bottom right-hand side of page 395 has a slightly different order of operations than previously learned. The equations in this lesson have brackets and you must deal with them. After you take care of the brackets, you multiply and divide, and then you add and subtract, as the order of operations was stated in previous lessons.

Self-Check

SC 1. Answer the "Show You Know" on page 395 of your textbook.

Compare your answers in the Appendix.

Read

How about solving equations by applying the reverse order of operations, similar to the ways you have solved equations in the previous lessons? Solve this type of equation using the reverse order of operations by studying "Example 2: Solve Equations" on page 396 of your textbook.

Notice how "Strategies" in the margin of page 396 suggests drawing a diagram. A diagram will help you to understand the problem and make an equation for it, because you will be able to see the numbers and relationships more easily. The first thought cloud tells you why you must multiply by 4 in the equation. The diagram makes it easier to understand what the thought cloud explains.

There are two methods given to isolating the variable s and finding a solution to this $a(x + b) = c$ form of equation. Method 1 has you divide by the number in front of the brackets. Choose this method, if that number divides easily into the number on the other side of the equal sign in the equation. Dividing by the number eliminates the bracket.

Method 2 is to use the **distributive property** first. "Literacy Link" in the margin on page 396 gives a definition for *distributive property*. This property means that the operation outside the bracket is distributed to every term inside the bracket. The property states that $a(b + c) = a \times b + a \times c$. For the equation in "Example 2," it means the "multiply by 4" in front of the bracket is distributed to both quantities inside the bracket.

distributive property: distributes the operation outside the bracket to every term inside the bracket

The property states that
$a(b + c) = a \times b + a \times c$.

$$4(b + c) = 4 \times (b + c)$$
$$= (4 \times b) + (4 \times c)$$
$$= 4b + 4c$$

Since there is a number 4 in front of the bracket, that means you have four sets of whatever is inside the brackets. Therefore, you multiply the number 4 by each item inside the bracket. The thought cloud in the margin near the bottom of page 396 shows the number 4 being distributed to both the s and the 8 in the quilt problem.

Notice that the textbook explains that you continue to check the solution, just as you have done in the previous lessons.

Self-Check

SC 2. Answer the "Show You Know" on page 396 of your textbook.

Compare your answers in the Appendix.

Read

Carefully study "Key Ideas" on page 397, and then transfer the main ideas to your foldable.

Connect

Now that you have studied how to solve and check two-step distributive property equations, how about applying that knowledge to some other equations and to questions involving practical situations? Put your skills to work by completing the Self-Check questions below.

Self-Check

SC 3. Complete "Communicate the Ideas" questions 1 and 2 on page 397 of the textbook.

Compare your answers in the Appendix.

SC 4. Complete "Check Your Understanding" questions 4, 6, 8, 10, 11, and 16 on pages 398 and 399 of the textbook.

Compare your answers in the Appendix.

Discuss any questions that you are having difficulty understanding with a partner or your teacher until you are sure you know how to do that type of question accurately. It's smart to ask questions.

Extra Practice

If you were able to accurately answer at least six of the above questions and you feel you have a solid understanding of how to model and solve two-step equations, go on to the assignment.

If you need a bit more practice, you may complete "Check Your Understanding" questions 5, 7, 9, 12, 13, 14, and 15 on pages 398 and 399 of your textbook. When you finish each question, check your work using the shortened answers on page 508 of the textbook. Make sure to contact your teacher if you still have questions after completing this additional practice.

Assignment

Go to the Unit 6 Assignment Booklet and complete "Unit 6: Lesson 7 Question Set."

Try This

In preparation for your Unit 6 Problem, consider the question about a scuba-diving trip to the Caribbean posed in the Get Focused section. In the equation $n(x + 70) = C$, the variable n is the number of days they will stay, the variable x is the cost of the hotel, 70 is the cost of two scuba dives per day, and C is the total cost of the hotel and a scuba-diving package.

TT 9. If they stay only five nights and the total cost of the hotel and scuba diving package is $1440, what will be the nightly cost of the hotel? Solve the equation, and show how you would check that your answer is correct.

TT 10. Rebecca and Navi are considering staying longer and booking a less expensive hotel. If they can find an acceptable hotel for $110 per night, how many days can they stay for the total cost of $1440? Solve the equation, and show how you would check that your answer is correct.

TT 11. If the choice was yours, would you rather stay in a less expensive hotel and do more scuba diving, or stay in the more expensive hotel and do less scuba diving? Explain why you feel that way.

Place a copy of your answers in your Math 8 course folder.

Discuss and Share

Post your responses to TT 9, 10, and 11 onto the discussion board. Then respond to two of the postings by stating whether their ways of arriving at the answers to the questions were basically the same as yours or different. Could the other methods still be accurate? Why?

Lesson Summary

In this lesson you modelled and solved problems involving two-step linear equations in the form $a(x + b) = c$. You modelled these problems and their equations with algebra tiles.

In solving the equations you discovered that there were two correct methods, and you can choose whichever one makes sense to you.

In the first method, you were shown how to divide both sides of the equation by the constant in front of the brackets. This is performing the opposite operation because the equation says to multiply the bracket by the number in front of it.

As you did in the previous lessons, you checked your solution by substituting the value of the solution into the equation to see if both the left and right sides then had the same value.

In the second method, you were shown how to use the distributive property first. This means that you multiply the values inside the bracket by the constant in front of the bracket. This follows the normal order of operations—to take care of the bracket first.

This concludes the lessons for Unit 6. You will have the opportunity in the Unit 6 Problem to apply what you have learned about writing and solving the five different types of equations studied.

Unit 6 Summary

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What would be your ultimate vacation? Would it be exploring new terrain on a mountain bike, surfing in Hawaii, or horseback riding in the mountains? Perhaps your ideal vacation is to join a humanitarian project and help people in some part of the world. Maybe eco-tourism appeals to you—visiting exotic places to watch wildlife while helping the environment. Or are you the type who would like an adventure vacation with physical challenges and the excitement of a little bit of danger?

The unit problem asks you to choose a dream vacation and research it.

- Where could you go?
- What choices of activities are available?
- What makes the vacation desirable to you?
- What is the cost of airfare or other transportation?
- What packages are available?
- What is the cost of hotels or other accommodation?
- How many days is your trip?

With this information, you would be in a good position to plan for your dream vacation. You will use this plan to demonstrate how the equations studied in this unit apply to real-life situations. Ask your teacher about the specific marking guidelines for this project, often called a marking rubric. Use the guidelines from your teacher to help you complete your project.

Project

Research a vacation of your choice using the Internet, travel brochures, or other sources of information. Using the results of your research, describe your dream vacation in a paragraph. Describe where you will be going, where you will eat and sleep, how long you will stay, and what you will be doing during that time. If you wish, explain why you have chosen this particular vacation.

You will need to complete the following tasks.

Task 1

Develop five equations that describe situations involving your vacation. Begin by reading "Wrap It Up!" on page 403 of the textbook. There are five equation types described on this page. You will create one equation for each of the equation types listed. You can use the My Guide to help you complete this task. Explain in words what each of the variables, coefficients, and constants represent. Go to the Math 8 Multimedia DVD and open the "Unit 6 Problem Organizer Table," and save or print a copy of the table. An example is provided below.

Equation Type	Equation	Vacation Situation	Variables, Coefficients, and Constants
$ax = b$	$5t = C$	cost of a sea-kayaking and whale-watching vacation	• t: time in days • C: total cost (excluding transportation)

Use the Unit 6 Problem Organizer Table to record your answers for Task 1.

My Guide

The following may help you complete Task 1:

- For the equation type $ax = b$, look back at question 6 of the Unit 6: Lesson 4 Question Set to see vacation examples where this type of equation is being used to describe a linear relation. Do you have something in your vacation that could form a similar equation?

- For the equation type $\frac{x}{a} = b$, look back at question 7 of the Unit 6: Lesson 4 Question Set to see how it is done. Make a similar equation for your vacation.

- For the equation type $ax + b = c$, look at the Get Focused in Lesson 5. You can find more examples in question 4 of the Unit 6: Lesson 5 Question Set and SC 4 and SC 5 to see instances where this type of equation is described. It is also used in question 3 of the Lesson 3 Question Set. How can you use the information researched about your vacation to make a similar equation?

- Equation type $\frac{x}{a} + b = c$ was highlighted in the Get Focused of Lesson 6 and in question 4 of the Unit 6: Lesson 6 Question Set.

- Examples of the fifth equation type, $a(x + b) = c$, are given in the Get Focused of Lesson 7. The equation is also used in question 4 of the Unit 6: Lesson 7 Question Set and TT 8.

Task 2

Solve each of the five equations using values that will work for the vacation you have researched.

My Guide

The example below is for the first equation: $ax = b$. The equation and data came from question 6 of the Unit 6: Lesson 4 Question Set, as well as the Get Focused in Lesson 4, where the 895 represents the cost of a 5-day vacation.

$5t = C$
$5t = 895$
$t = 179$

It would cost \$179 per day for the 5-day experience.

Check:
Left Side $= 5t$ Right Side $= 895$
$= 5(179)$
$= 895$
Left Side = Right Side

The solution is correct.

Task 3

Choose one of the equations, and show the relationship between two of the variables by making a table of values.

My Guide

See an example of constructing a table of values from a linear relationship and drawing the graph in Lesson 2. Look at "Math Link" on page 351, which you completed in Lesson 2.

Question 3 of the Unit 6: Lesson 1 Question Set asks you to make a table of values about a cost arising during a vacation.

Task 4

Make graph of the equation from the table of values in Task 3.

Task 5

Describe the relationship between two variables in words, and explain how you can tell whether or not this is a linear relation. Explain why it would or would not be reasonable to have points between the ones on your graph.

Task 6

Explain how at least one of your equations may change, based on circumstances surrounding your vacation. Some possible changes would, for example, be the time of the trip or specific costs for hotels, airfare, transportation, and extra perks. Write a new equation to reflect the change.

My Guide

To see an example of how at least one of your equations may change based on circumstances surrounding your vacation, look at parts d) and e) of "Math Link" on page 341 of your textbook. You answered that question toward the end of Lesson 1.

Other examples that you have worked with are found in TT 3 of Lesson 5 and TT 9 and TT 10 of Lesson 7.

Unit 6: Linear Equations and Graphing

Unit Summary

Through trying to answer each lesson's critical question, you have developed strategies to answer this Unit 6 question: How can equations help in planning an eco-travel or adventure trip?

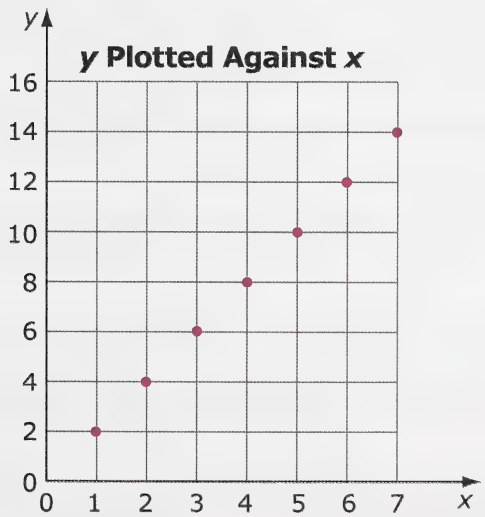
First, you looked at graphs of linear relations and described the fact that they form straight-line patterns.

You then created tables of values from the points on the graphs.

Next, you looked at tables of values and learned to tell if they represented a linear relation by seeing if consecutive values of the variables had corresponding differences. In the following data table, for example, the differences between consecutive values of x are always 1, while the differences between consecutive values of y are always 2.

x	1	2	3	4	5	6	7
y	2	4	6	8	10	12	14

These consistent differences indicate that there is a linear relation between x and y. Drawing the graph and looking at the straight-line pattern confirms that the relationship between x and y is linear. Notice that the graph has a title and the axes are labelled with x and y.



You created a graph from a formula and an equation by first making a table of values. You discovered that each graph should have both an x and y axis and that the graph needs a title.

Units, if there were any, should be included in the title. Once the graph was drawn, you were able to answer questions and solve problems from the information contained in the graph.

You found that, for some graphs, it was appropriate to have values in between the points plotted. For example, it would be appropriate to have points in between for a distance–time graph for a moving object, because any small increase in time would still mean the distance also changed.

For other graphs, it was not appropriate to have values in between the points plotted, depending on the situation represented by the graph. For example, it would not be appropriate to have points in between those plotted if the points represented consecutive days (plotted on the horizontal axis) and the cost of a hotel room (plotted on the vertical axis). The hotel does not let out rooms for part of a day, so there should be no points in between whole days.

Next, you modelled and solved linear problems using equations. You discovered that some equations could be solved by inspection. It was helpful, however, to model other equations with algebra tiles or with diagrams. You solved equations by applying the opposite operation to isolate the variable.

For division equations, such as $\frac{r}{5} = 2$, you performed the opposite operation by multiplying both sides of the equation by the denominator.

You discovered that you could check or verify the solution by substituting the value of the solution into the equation. Keeping the left side of the equation separate from the right side as you substituted the solution in, allowed you to tell if the solution was correct. If it was, the left side and the right side would be equal.

For two-step equations in the form $ax + b = c$, you modelled them and found the solution using blocks and a balance scale. You also modelled them with algebra tiles. You learned to isolate the variable by again performing the opposite operations.

The second step in the two-step process is to perform the opposite operation of dividing both sides.

Your solution can be checked by substituting it into the equation. You would still separate the equation into left side and right side, as you did when checking the previous types.

You also learned to model and solve equations in the form $\frac{x}{a} + b = c$.

You learned to solve this type of equation by again performing the opposite operations in two steps.

The final type of equation that you learned to solve in this unit was in the form $a(x + b) = c$. You modelled this type of equation with algebra tiles, and you solved these equations in two slightly different ways.

The first method of solving this type of equation requires you to divide both sides of the equation by the number in front of the bracket. Then the equation is solved by applying the opposite addition or subtraction operation.

The second method of solving this type of equation requires you to multiply both of the quantities inside the bracket by the number in front of the bracket. Doing this is using the distributive property. Then the variable is isolated using the opposite operations you have practiced with the other types of equations.

The solution is checked the same way as the other types of equations, by separating the left side from the right side and substituting in the value of the variable.

Each type of equation represents a problem in the real world. These equations were not just mathematical exercises or mental games. You applied these equations as you planned a vacation in the Unit 6 problem.

Unit Review

Reinforcing the concepts and skills of this unit is an important part of long-term understanding of math concepts. Take the time to look over your foldables for this unit until all the ideas are fresh in your mind. Then challenge yourself by completing the following Self-Check questions. If any questions are too puzzling for you to figure out, contact your teacher for assistance.

Self-Check

SC 1. Turn to "Chapter 9 Review" on pages 360 and 361.

a. Complete questions 1, 2, 3, 4, 5, and 6.

b. Complete at least two questions from each of the three text sections shown.

SC 2. Turn to "Chapter 10 Review" on pages 400 and 401.

a. Complete questions 1, 2, 3, 4, 5, 6, and 7.

b. Complete at least three questions from each of the four text sections shown.

Compare your answers in the Appendix.

Are You Ready?

You've done a lot of work to reach this point in the unit, haven't you? But are you ready to strut your stuff—that is, show your mastery of the new concepts and skills? Are you really ready to take the challenge of a unit test?

You may feel you are ready but you'd like to do a practice test before doing one for marks. Well, here's your chance—in the following Self-Check questions. The questions just confirm in your own mind how well you can do at this point. Then if you have some questions, you can get them answered ahead of time. Or if you feel you might need some more support in an area, you can ask your teacher for a little help.

Self-Check

There are two chapters in this unit, so there are two practice tests for this unit. Ask your teacher whether you should do the odd questions or the even questions on both tests.

SC 3. Turn to pages 362 and 363, and complete the designated questions in "Practice 9 Test."

Compare your answers in the Appendix.

SC 4. Turn to pages 402 and 403, and complete the designated questions in "Practice 10 Test."

Compare your answers in the Appendix.

Assignment

Check with your teacher about a Unit 6 test.

Appendix

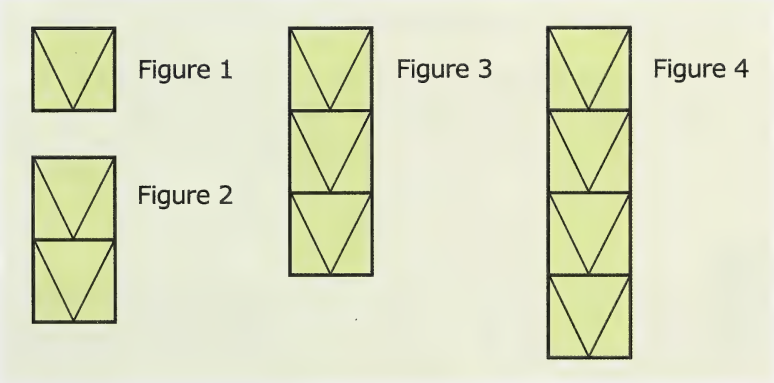
Lesson 1

SC 1.

a. The following are three patterns that could be described:

- The points lie in a straight line.
- The points all lie on cross-lines of the graph (where horizontal and vertical lines on the graph intersect).
- To move from one point to the next, go one unit horizontally and three units vertically.

b. Many patterns are possible. Here is one example.



c.

Figure Number	Number of Triangles
1	3
2	6
3	9
4	12

d. Let f represent the figure number. Then the number of triangles is $3f$, which means 3 times f.

$$\begin{aligned}\text{Number of triangles in figure } 99 &= 3\text{f} \\ &= 3(99) \\ &= 297\end{aligned}$$

There are 297 triangles in figure 99.

SC 2.

a. The following patterns appear on the graph:

- The points lie in a straight line.
- The points make a line that slants upward and to the right.
- The points all lie on cross-lines of the graph.
- The cost of one notebook is $2; the cost of two notebooks is $4; and so on.
- The cost increases $2 for each additional notebook.
- To move from one point to the next, go one unit horizontally and two units vertically.
- The cost of the notebooks (in dollars) is two times the number of notebooks.

b. The cost per notebook is $2. A variety of reasons could be given. One possibility is that the cost of the notebooks (in dollars) is always twice the number of notebooks. If you look at the graph and find the point that represents 1 notebook, you will see that the matching price is $2.

c.

Number of Notebooks	1	2	3	4
Cost ($)	2	4	6	8

d. No, it is not possible to have points between the ones on the graph. Notebooks are only sold in whole numbers. It does not make sense to sell half of a notebook.

SC 3.

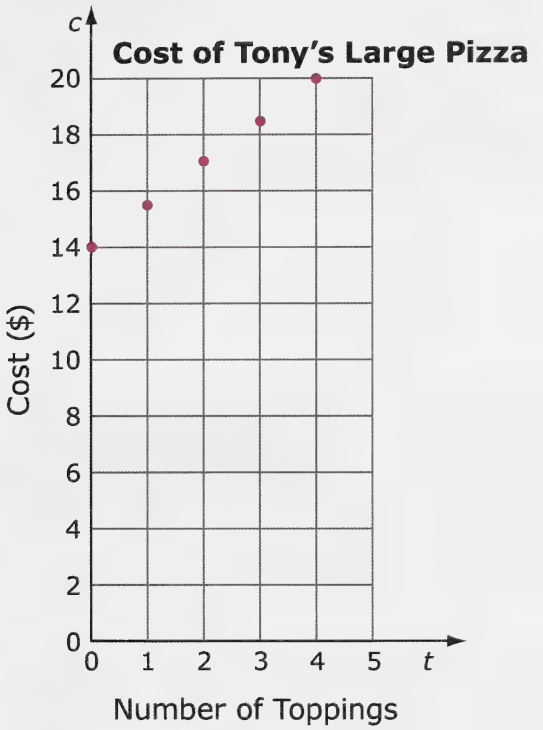
1. Answers will vary. A sample answer is given.

It is reasonable to have points between those on Graph A because it is possible to travel a part of a kilometre. It is not reasonable to have points between those on Graph B because stores do not sell partial cartons of ice cream.

3. Answers will vary. A sample answer is given.

A graph and a table of values are different in that the graph shows a picture of the data, from which you can see a pattern, whereas the table of values does not provide a picture.

A graph and a table of values are similar in that they both represent the same values. Look at the following example.



Number of Toppings, t	0	1	2	3	4
Cost, C ($)	14.00	15.50	17.00	18.50	20.00

SC 4. Check your work using the answers given on pages 501 and 502 of your textbook. A more detailed answer to question 11.d. is provided here.

11.d. Answers will vary. A sample answer is given.

From the graph, \$60 earns \$3 interest. Think of \$180 as 3 x \$60. To get the interest on \$180, add the interest on \$60 three times.

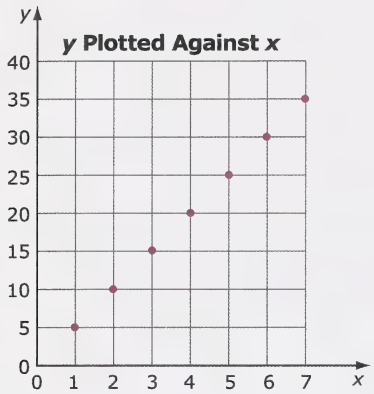
\$3 + \$3 + \$3 = \$9

The simple interest earned on \$180 after one year is \$9.

Lesson 2

SC 1.

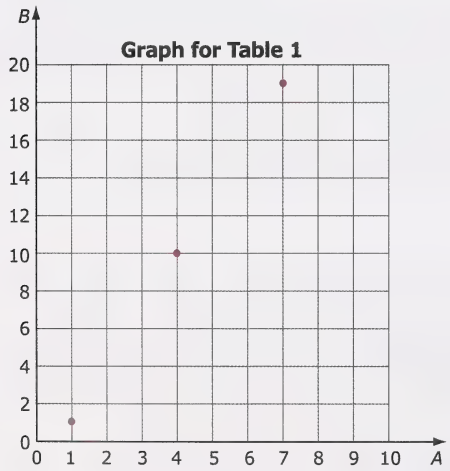
a.



b. The difference in value for consecutive x-values is 1. The difference in value for consecutive y-values is 5.

c. The y-values are five times the x-values.

d. The expression for y in terms of x is $5x$.



SC 2. Table 1 is a linear relation because the difference in consecutive values of A is always 3 and the difference in consecutive values of B is always 9.

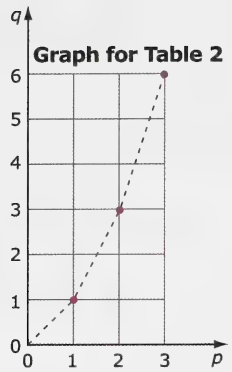


Table 2 is not a linear relation because the difference in consecutive values of A is always 1 but the difference in consecutive values of B changes from 1 to 2 to 3. Graphing the values will give further evidence.

The graph for Table 1 shows a linear relation because the points lie in a straight line. On the other hand, the graph for Table 2 does not show a linear relation because the points do not lie in a straight line.

SC 3.

a.

Number of subscriptions, n	0	5	10	15	20	25
Pay, P ($)	0	20	40	60	80	100

b. Yes, it is a linear relation. The consecutive values of n have the same difference of 5, and the consecutive values of P have the same difference of 20.

c. The expression for Sky's pay in relation to the number of subscriptions she sells is $4n$. You can figure out this expression by looking at the table of values. You always need to multiply the number of subscription by 4 to get the corresponding cost (e.g., 5 x 4 = 20, 10 x 4 = 40).

d. If Sky sells 40 subscriptions, she receives $160.

SC 4.

1. Tim is correct. Different people may give different reasons. Example of a correct reason: The relation is linear because the difference between consecutive values of m is 2, and the difference between consecutive values of a is 2.

3. Sometimes a variety of answers may be given for the examples: You can usually determine if the relationship is linear by calculating the differences between the consecutive values of the variables. If consecutive values for one variable have the same difference, and consecutive values for the other variable each have the same difference, even if that difference is not the same as for the first variable, the relationship is linear. However, if the differences between the consecutive values of the first variable are not the same, it is difficult to determine if the relationship is linear. The table below shows such a situation.

Number of Toppings, t	0	1	2	4
Cost, C ($)	14.00	16.00	18.00	22.00

SC 5.

4. Check the answers on page 502 of the textbook.

6. Check the answers on page 502 of the textbook.

8. Check the answers on page 503 of the textbook.

10.a.–b. Check the answers on page 503 of the textbook.

c. The expression is $90t$.

d. A variety of ways to arrive at the answer are possible. Here is one way: Use the expression from 10.c. The number of words Mara reads is $90t$. If t is 12, the number of words is 90×12.

$90 \times 12 = 1080$

Mara reads 1080 words in 12 minutes.

12.a. Check your answers on page 503 of the textbook.

Other combinations than the ones given on page 503 are possible, such as 18 quarters and 15 dimes or 22 quarters and 5 dimes. The number of quarters must be multiples of 2 (that is, even numbers) or you can't add dimes to get an even \$6. The number of dimes must be multiples of 5, and the total amount must add to \$6.

b. Check your answers on page 503 of the textbook.

c. Check your answers on page 503 of the textbook.

d. Because there must be both dimes and quarters, 2 quarters is the smallest number that can be there. So that leaves \$5.50 in dimes or 55 dimes. The smallest number of dimes must be 5, so that leaves \$5.50 in quarters or 22 quarters.

14.a. Check your answers on page 503 of the textbook.

b. The expression is $3n + 1$, where n is the number of the figure.

c. Use the expression developed in 14.b. and put 20 in for n.

$3n + 1$
$3(20) + 1$
$60 + 1$
61

d. One way to find the answer is to work out, like you did in 14.c, that there are 31 squares for Figure 10. Then you can subtract 31 from 61 to get 30 squares for an answer.

Another way is to see from the table that when the number of the figure goes up by 1, the number of squares goes up by 3. So if the number of the figure goes up by 10, the number of squares will go up by 30 ($3 \times 10 = 30$). There are other ways to arrive at the answer.

16.a.–c. Check your answers on page 504 of the textbook.

d. One way to answer the question is to see where the graph points would go if they went in a straight line to 13°. Another way is to see that 13° is 2 less than 15°. The height difference in the table to get a 2° change is 300 m. So add 300 m to the height for 15°.

$750 + 300 = 1050$

The height you would have climbed if the temperature is 13°C is 1050 m.

Lesson 3

SC 1.

a.

Rental Time, t (h)	1	2	3	4	5	6	7
Rental Cost, C ($)	8	16	24	32	40	48	56

b.

c. No, it is not reasonable to have points between those on the graph because the company charges for whole hours only.

d. The formula is $C = 8t$.

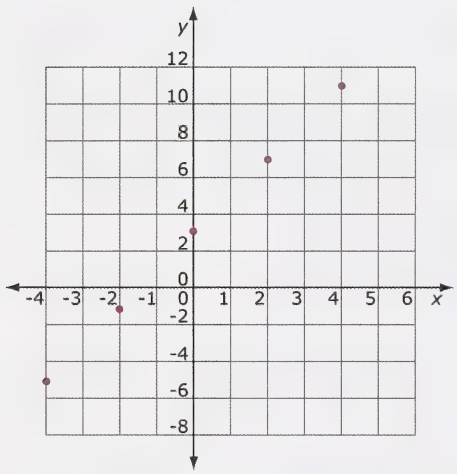
The cost to rent the lawnmower for 12 h is \$96.
$C = 8t$
$C = 8(12)$
$C = 96$

SC 2.

a. Answers will vary. A sample answer is given.

x	−4	−2	0	2	4
y	−5	−1	3	7	11

b.



c. The coordinates for the point that lie on the y-axis are (0, 3). When a point lies on the y-axis, the x value for that point is always 0.

SC 3.

1.a. Answers will vary. A sample answer is given.

The value of y for all points on the x-axis is zero.

b. Answers will vary. A sample answer is given.

The value of x for all points on the y-axis is zero.

2. Answers will vary. A sample answer is given.

Method 1: Substitute 4 for x in the formula $y = 2x - 1$; then calculate $2(4) - 1 = 7$.

Method 2: Find the common difference between consecutive y values, which is 2; then add 2 to 5 to find the missing value ($5 + 2 = 7$).

3.a. Answers will vary. A sample answer is given.

Choose reasonable integer values that are within the context of the situation and are equal intervals apart. Choose numbers that make sense in the question you are looking at. Choose numbers that increase by the same amount (e.g., 2, 4, 6 or 5, 10, 15).

b. Answers will vary. A sample answer is given.

The calculation is usually fairly simple when zero is substituted into an equation. Also, it is often useful to have zero for a value of x as a starting point or midpoint for a graph.

Lesson 4

SC 1.

a. There are at least three ways to solve the question. This is the inspection method: For $-3t = -36$, ask yourself this question: "What number multiplied by –3 equals –36?" Or you can ask yourself, "What number results from dividing –36 by –3?" In each case, the answer is 12.

Check:

$$\begin{aligned} \text{Left Side} &= -3t \qquad \text{Right Side} = -36 \\ &= -3(12) \\ &= -36 \end{aligned}$$

Left Side = Right Side

The solution is correct.

b. There are at least three ways to solve the question. This is the inspection method: For $\frac{n}{3} = -7$, ask yourself, "What number divided by 3 equals –7?" Or ask yourself, "What number results from multiplying –7 by 3?" In each case, the answer is –21.

Check:

$$\text{Left Side} = \frac{n}{3} \qquad \text{Right Side} = -7$$
$$= \frac{-21}{3}$$
$$= -7$$

Left Side = Right Side

The solution is correct.

SC 2.

a. For $-5b = -45$, the equation says to multiply the variable by –5. So to apply the opposite operation strategy, divide both sides of the equation by -5.

$$\frac{-5b}{-5} = \frac{-45}{-5}$$
$$b = 9$$

Check:

$$\text{Left Side} = -5b \qquad \text{Right Side} = -45$$
$$= -5(9)$$
$$= -45$$
$$\text{Left Side} = \text{Right Side}$$

The solution is correct.

b. For $6f = -12$, the equation says to multiply the variable by 6. So to apply the opposite operation strategy, divide both sides of the equation by 6.

$$\frac{6f}{6} = \frac{-12}{6}$$
$$f = -2$$

Check:

$$\text{Left Side} = 6f \qquad \text{Right Side} = -12$$
$$= 6(-2)$$
$$= -12$$
$$\text{Left Side} = \text{Right Side}$$

The solution is correct.

SC 3.

a. For $\frac{d}{-5} = 3$, the equation says to divide the variable by –5. Apply the opposite operation strategy by multiplying both sides of the equation by –5.

$$\frac{d}{-5} \times -5 = 3 \times -5$$
$$d = -15$$

Check:

$$\text{Left Side} = \frac{d}{-5} \qquad \text{Right Side} = 3$$
$$= \frac{-15}{-5}$$
$$= 3$$
$$\text{Left Side} = \text{Right Side}$$

The solution is correct.

b. For $-6 = \frac{p}{7}$, the equation says to divide the variable by 7. Apply the opposite operation strategy by multiplying both sides of the equation by 7.

$-6 \times 7 = \frac{p}{7} \times 7$

$-42 = p$

Check:

Left Side $= -6$

Right Side $= \frac{p}{7}$

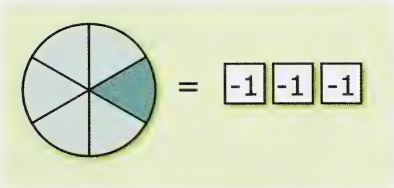
$= \frac{-42}{7}$

$= -6$

The solution is correct.

SC 4.

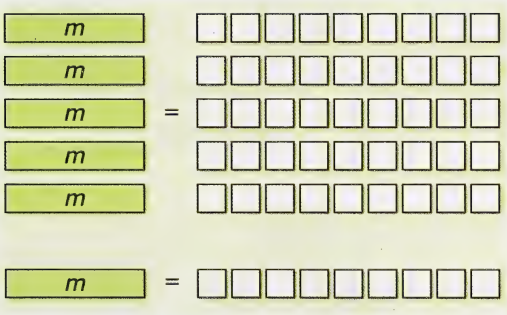
1.



The shaded part of the circle stands for $\frac{x}{6}$ or x ÷ 6. The three white squares on the right side of the equal sign represent –3.

3.a. Let the variable be *n*. The equation is $5n = -45$.

b.



4. Raj's solution is incorrect. He multiplied each side of the equation by –9 when he should have multiplied by +9. The correct answer is n = –36.

SC 5.

5.a.–b. Check the answers on page 507 of the textbook.

7. Check the answers on page 507 of the textbook.

8. Check the answers on page 507 of the textbook.

10. Check the answers on page 507 of the textbook.

11. Check the answers on page 507 of the textbook.

13.a. $4s = -12$

$\frac{4s}{4} = \frac{-12}{4}$

$s = -3$

Check: Left Side $= 4s$ Right Side $= -12$

$= 4(-3)$

$= -12$

Left Side = Right Side

The solution is correct.

b. $-156 = -12j$

$\frac{-156}{-12} = \frac{-12j}{-12}$

$13 = j$

Check: Left Side $= -156$ Right Side $= -12j$

$= -12(13)$

$= -156$

Left Side = Right Side

The solution is correct.

15. Check the answers on page 507 of the textbook.

19. Check the answers on page 507 of the textbook.

17.a. $\frac{t}{3} = -12$

$\frac{t}{3} \times 3 = -12 \times 3$

$t = -36$

Check: Left Side $= \frac{t}{3}$ Right Side $= -12$

$= \frac{-36}{3}$

$= -12$

Left Side = Right Side

The solution is correct.

b. $12 = \frac{h}{-10}$

$12 \times -10 = \frac{h}{-10} \times -10$

$-120 = h$

Check: Left Side $= 12$ Right Side $= \frac{h}{-10}$

$= \frac{-120}{-10}$

$= 12$

Left Side = Right Side

The solution is correct.

22.a. You can choose any variable. For this example, let n represent the number of litres of gas Nakasuk needs to travel to his aunt's community. Then the equation is $13n = 312$.

b. $13n = 312$

$$\frac{13n}{13} = \frac{312}{13}$$

$$n = 24$$

Nakasuk needs 24 litres of gas.

24.a. Lucy is making four pair of mitts. Therefore, she has a total of eight mitts. You can choose any variable. For this example, let the amount of trim she has for each mitt be m centimetres. Then the equation is $8m = 144$.

b. $8m = 144$

$$\frac{8m}{8} = \frac{144}{8}$$

$$m = 18$$

Check:

Left Side $= 8m$
$= 8(18)$
$= 144$

Right Side $= 144$

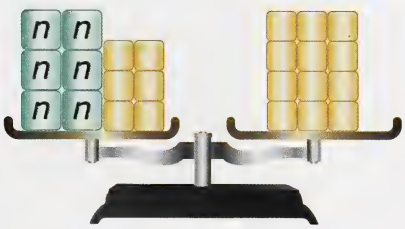
Left Side = Right Side

The solution is correct. Lucy has 18 cm of trim for each mitt.

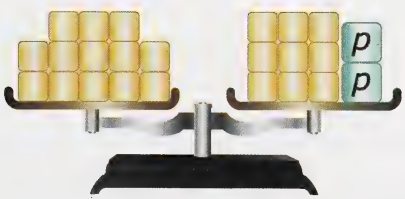
Lesson 5

SC 1.

a) $n=1$

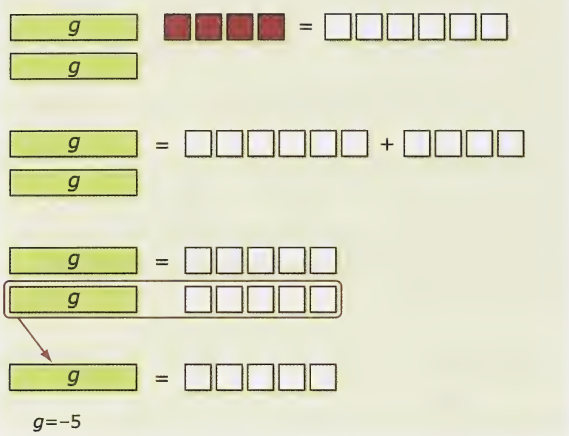


b) $p=2$



SC 2.

a) $2g+4=-6$

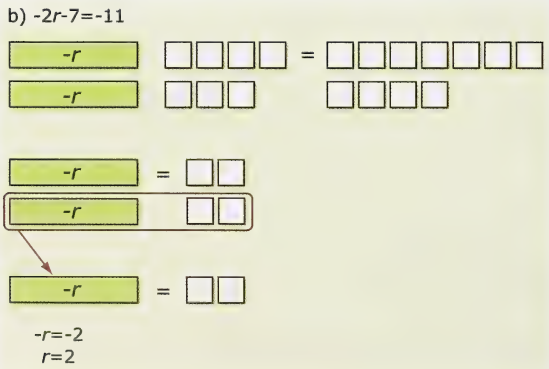


Check:

$$\begin{aligned}\text{Left Side} &= 2g+4 \qquad \text{Right Side} = -6\\ &= 2(-5)+4\\ &= -10+4\\ &= -6\\ &\text{Left Side} = \text{Right Side}\end{aligned}$$

The solution is correct.

b) $-2r-7=-11$



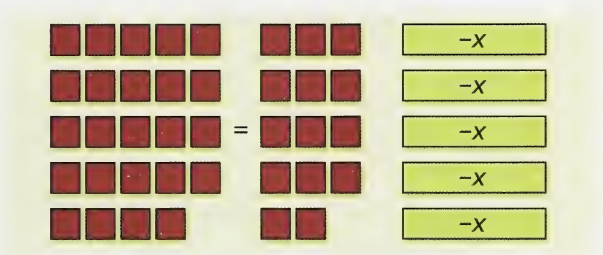
Check:

$$\begin{aligned}\text{Left Side} &= -2r - 7 \qquad \text{Right Side} = -11\\ &= -2(2) - 7\\ &= -4 - 7\\ &= -11\\ &\text{Left Side} = \text{Right Side}\end{aligned}$$

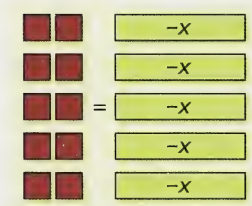
The solution is correct.

SC 3.

1. $24 = 14 - 5x$



Subtract 14 positive (coloured) tiles from both sides.



Divide both sides by 5.

Since $-x = 2$, it follows that $x = -2$. (Multiply both sides of $-x = 2$ by -1.)

2. a. To isolate the variable, subtract 10 from both sides of the equation. Then divide both sides of the equation by 5.

b. Answers will vary. A sample answer is given.

Instead of subtracting 10 from both sides of the equation, add 10 to both sides. Then divide both sides of the equation by 5 (as in part 2.a.).

SC 4. Check your work using the answers given on pages 507 and 508 of your textbook. More detailed solutions to questions 9, 12.b), 14.b), and 16 are provided here.

9. a.

$$\begin{aligned} 6r+6&=18\\ 6r+6-6&=18-6\\ 6r&=12\\ \frac{6r}{6}&=\frac{12}{6}\\ r&=2 \end{aligned}$$

Check:

$$\begin{aligned} \text{Left Side}&=6r+6 \qquad \text{Right Side}=18\\ &=6(2)+6\\ &=12+6\\ &=18\\ &\text{Left Side}=\text{Right Side} \end{aligned}$$

The solution is correct.

b.

$$\begin{aligned} 4m+8&=12\\ 4m+8-8&=12-8\\ 4m&=4\\ \frac{4m}{4}&=\frac{4}{4}\\ m&=1 \end{aligned}$$

Check:

$$\begin{aligned} \text{Left Side}&=4m+8 \qquad \text{Right Side}=12\\ &=4(1)+8\\ &=4+8\\ &=12\\ &\text{Left Side}=\text{Right Side} \end{aligned}$$

The solution is correct.

c.

$$\begin{aligned} 39+9g&=75\\ 39+9g-39&=75-39\\ 9g&=36\\ \frac{9g}{9}&=\frac{36}{9}\\ g&=4 \end{aligned}$$

Check:

$$\begin{aligned} \text{Left Side}&=39+9g \qquad \text{Right Side}=75\\ &=39+9(4)\\ &=39+36\\ &=75\\ &\text{Left Side}=\text{Right Side} \end{aligned}$$

The solution is correct.

d.

$$-37 = 8f - 139$$
$$-37 + 139 = 8f - 139 + 139$$
$$102 = 8f$$
$$\frac{102}{8} = \frac{8f}{8}$$
$$12.75 = f$$

Check:

$$\text{Left Side} = -37 \qquad \text{Right Side} = 8f - 139$$
$$= 8(12.75) - 139$$
$$= 102 - 139$$
$$= -37$$
$$\text{Left Side} = \text{Right Side}$$

The solution is correct.

12. b.

$$3s - 30 = 750$$
$$3s - 30 + 30 = 750 + 30$$
$$3s = 780$$
$$\frac{3s}{3} = \frac{780}{3}$$
$$s = 260$$

Check:

$$\text{Left Side} = 3s - 30 \qquad \text{Right Side} = 750$$
$$= 3(260) - 30$$
$$= 780 - 30$$
$$= 750$$
$$\text{Left Side} = \text{Right Side}$$

The solution is correct.

Matt has saved \$260 so far.

14. b.

$$4s + 2 = 14$$
$$4s + 2 - 2 = 14 - 2$$
$$4s = 12$$
$$\frac{4s}{4} = \frac{12}{4}$$
$$s = 3$$

Check:

$$\text{Left Side} = 4s + 2 \qquad \text{Right Side} = 14$$
$$= 4(3) + 2$$
$$= 12 + 2$$
$$= 14$$
$$\text{Left side} = \text{Right side}$$

The solution is correct.

The percent of students who chose skiing is 3%.

16. Let w be the width of the classroom. Then the length of the classroom will be $2w - 3$. Since the length is also 9 m, $2w - 3 = 9$.

$$\begin{aligned} 2w-3&=9\\ 2w-3+3&=9+3\\ 2w&=12\\ \frac{2w}{2}&=\frac{12}{2}\\ w&=6 \end{aligned}$$

Check:

$$\begin{aligned} \text{Left Side}&=2w-3 \qquad \text{Right Side}=9\\ &=2(6)-3\\ &=12-3\\ &=9\\ &\text{Left Side}=\text{Right Side} \end{aligned}$$

The solution is correct.

The width of the classroom is 6 m.

SC 5.

$$\begin{aligned} 5+10t&=45\\ 5+10t-5&=45-5\\ 10t&=40\\ \frac{10t}{10}&=\frac{40}{10}\\ t&=4 \end{aligned}$$

Check:

$$\begin{aligned} \text{Left Side}&=5+10t \qquad \text{Right Side}=45\\ &=5+10(4)\\ &=5+40\\ &=45\\ &\text{Left Side}=\text{Right Side} \end{aligned}$$

The solution is correct.

The stone fell for 4 seconds before it hit the water.

SC 6.

a.
$$\begin{aligned} C&=350n+2650\\ 6500&=350n+2650\\ 6500-2650&=350n+2650-2650\\ 3850&=350n\\ \frac{3850}{350}&=\frac{350n}{350}\\ 11&=n \end{aligned}$$

If the cost of the trip is \$6500, then the trip would last 11 days.

b. If you booked a cheaper flight, the cost of the trip would be less. The 2650 in the equation would become a smaller number.

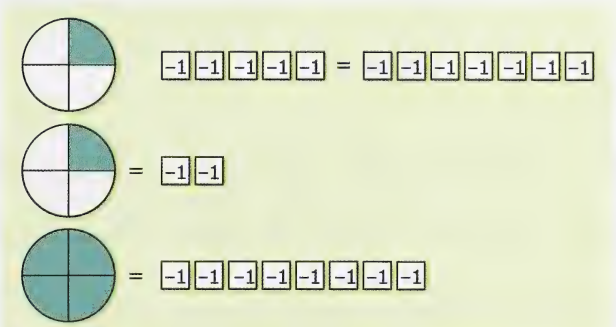
c. If the daily cost went up by \$30, the coefficient of n would increase by 30. The equation would become $C = (350 + 30)n + 2650$ or $C = (380)n + 2650$.

Lesson 6

SC 1.

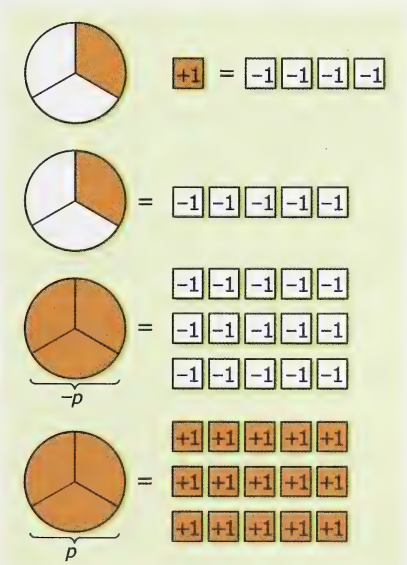
a.

$$\frac{x}{4} - 5 = -7$$
$$\frac{x}{4} - 5 + 5 = -7 + 5$$
$$\frac{x}{4} = -2$$
$$\frac{x}{4} \times 4 = -2 \times 4$$
$$x = -8$$



b.

$$\frac{-p}{3} + 1 = -4$$
$$\frac{-p}{3} + 1 - 1 = -4 - 1$$
$$\frac{-p}{3} = -5$$
$$\frac{-p}{3} \times 3 = -5 \times 3$$
$$-p = -15$$
$$p = 15$$



SC 2.

a.

$$\frac{-x}{12}-6=4$$
$$\frac{-x}{12}-6+6=4+6$$
$$\frac{-x}{12}=10$$
$$\frac{-x}{12}\times 12=10\times 12$$
$$-x=120$$
$$x=-120$$

b:

$$-4=3+\frac{k}{7}$$
$$-4-3=3-3+\frac{k}{7}$$
$$-7=\frac{k}{7}$$
$$-7\times 7=\frac{k}{7}\times 7$$
$$-49=k$$

SC 3.

2. Answers may vary. Example: Subtract 12 from both sides of the equation. Since $-\frac{n}{5}$ is the same as $+\frac{n}{-5}$, multiply both sides of the equation by –5. The answer should be $n = 30$.

3. No, Manjit's solution is incorrect. Answers may vary.

- Example 1: He should subtract 7 from both sides of the equation and then multiply both sides of the equation by –4. The solution is $x = -8$.
- Example 2: If he was to multiply both sides by –4, he would need to multiply the 7 by –4 also. He could still solve the equation, but it is more work than subtracting first and involves bigger numbers.

SC 4.

4. You may check your answers on page 508 of the textbook; however, more complete solutions are provided.

a. The equation is $\frac{x}{3}-2=5$.

b. The equation is $3=\frac{-b}{2}-6$.

6. Check the answers on page 508 of the textbook.

8. Check the answers on page 508 of the textbook.

9. Check the answers on page 508 of the textbook.

10. Check the answers on page 508 of the textbook; however, more complete solutions are provided.

a.
$$2+\frac{m}{3}=18$$
$$2-2+\frac{m}{3}=18-2$$
$$\frac{m}{3}=16$$
$$\frac{m}{3}\times 3=16\times 3$$
$$m=48$$

Check:
$$\text{Left Side}=2+\frac{m}{3}$$
$$=2+\frac{48}{3}$$
$$=2+16$$
$$=18$$

Right Side = 18

Left Side = Right Side

The solution is correct.

b.
$$\frac{c}{-8}-8=-12$$
$$\frac{c}{-8}-8+8=-12+8$$
$$\frac{c}{-8}=-4$$
$$\frac{c}{-8}\times -8=-4\times -8$$
$$c=32$$

Check:
$$\text{Left Side}=\frac{c}{-8}-8$$
$$=\frac{32}{-8}-8$$
$$=-4-8$$
$$=-12$$

Right Side = –12

Left Side = Right Side

The solution is correct.

14. Check the answer on page 508 of the textbook.

16. Check the answer on page 508 of the textbook.

SC 5.

a. A variety of answers may be given. Examples:

- The points on the graph appear to lie in a straight line.
- The points go from upper left to lower right on the graph.
- The highest temperature is 15°C, and the temperature steadily decreases to about –50°C.
- The altitude ranges from 0 m to 10 000 m.

b. Answers may vary. Examples:

The graph points form a straight line, and the equation is a linear relation.

The constant in the equation is 15 and the graph starts at $t = 15$.

c. You can try to read the value off the graph—you should find a value between 2000 m and 3000 m, but closer to 2000 m. A better solution is to solve the equation for when t is equal to 0°C. This will give us the most accurate answer.

$$t = 15 - \frac{h}{154}$$
$$0 = 15 - \frac{h}{154}$$
$$0 - 15 = 15 - 15 - \frac{h}{154} \quad \text{(Remember, } -\frac{h}{154} \text{ is the same as } \frac{h}{-154}.\text{)}$$
$$-15 = \frac{h}{-154}$$
$$-15 \times -154 = -\frac{h}{-154} \times 154$$
$$2310 = h$$

The temperature is 0°C at a height of 2310 m.

17.a.

$$a = \frac{C}{100} - 17$$
$$14 = \frac{C}{100} - 17$$
$$14 + 17 = \frac{C}{100} - 17 + 17$$
$$31 = \frac{C}{100}$$
$$31 \times 100 = \frac{C}{100} \times 100$$
$$3100 = C$$

Tom should consume 3100 calories.

b.

$$a = \frac{C}{100} - 13$$
$$14 = \frac{C}{100} - 13$$
$$14 + 13 = \frac{C}{100} - 13 + 13$$
$$27 = \frac{C}{100}$$
$$27 \times 100 = \frac{C}{100} \times 100$$
$$2700 = C$$

This is greater than the recommended amount.

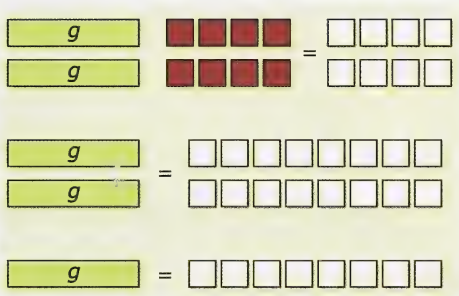
c.

$$a = \frac{C}{100} - x$$
$$14 = \frac{2100}{100} - x$$
$$14 = 21 - x$$
$$14 - 21 = 21 - 21 - x$$
$$-7 = -x$$
$$7 = x$$

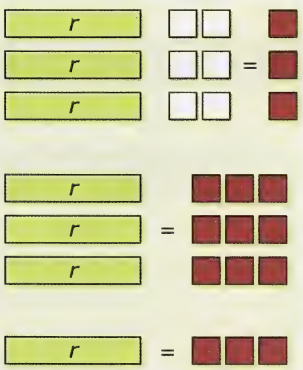
Lesson 7

SC 1.

a. $2(g+4) = -8$
$2g + 8 = -8$
$2g = -16$
$g = -8$



b. $3(r-2) = 3$
$3r - 6 = 3$
$3r = 9$
$r = 3$



SC 2. Both method 1 and method 2 were used to answer the "Show You Know" questions. You can use two different methods, but still arrive at the same correct answer.

a.

Method 1	Method 2
$-2(x-3)=12$ $\frac{-2(x-3)}{-2}=\frac{12}{-2}$ $x-3=-6$ $x-3+3=-6+3$ $x=-3$	$-2(x-3)=12$ $-2x+6=12$ $-2x+6-6=12-6$ $-2x=6$ $\frac{-2x}{-2}=\frac{6}{-2}$ $x=-3$

Check: Left Side $=-2(x-3)$ Right Side = 12

$=-2(-3-3)$

$=-2(-6)$

$=12$

Left Side = Right Side

The solution is correct.

b.

Method 1	Method 2
$-20=5(3+p)$ $\frac{-20}{5}=\frac{5(3+p)}{5}$ $-4=3+p$ $-4-3=3-3+p$ $-7=p$	$-20=5(3+p)$ $-20=15+5p$ $-20-15=15-15+5p$ $-35=5p$ $\frac{-35}{5}=\frac{5p}{5}$ $-7=p$

Check: Left Side $=-20$ Right Side $=5(3+p)$

$=5(3+-7)$

$=5(-4)$

$=-20$

Left Side = Right Side

The solution is correct.

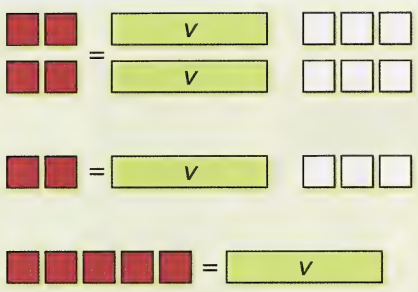
SC 3.

1. A variety of answers is possible. Example:

$4 = 2(v - 3)$

Divide both sides of the equation by 2. Add 3 to both sides of the equation.

The solution is $v = 5$.



2. No, neither strategy is correct. A variety of answers is possible. Example: Julia cannot subtract the number 2 from both sides of the equation because the number 2 is still inside the brackets. Chris only divided the right side of the equation by –6, but he should have divided both sides by –6.

SC 4.

4.a. The equation is $2(x - 3) = 6$. Either of the methods shown below will work to solve the equation.

Method 1	Method 2
$\frac{2(x-3)}{2} = \frac{6}{2}$ $x-3=3$ $x-3+3=3+3$ $x=6$	$2(x-3)=6$ $2x-6=6$ $2x-6+6=6+6$ $2x=12$ $\frac{2x}{2}=\frac{12}{2}$ $x=6$

Check:

$$\begin{aligned}\text{Left Side} &= 2(x-3) \qquad \text{Right Side} = 6\\ &= 2(6-3)\\ &= 2(3)\\ &= 6\end{aligned}$$

Left Side = Right Side

The solution is correct.

b. The equation is $3(s-2)=9$.

Method 1	Method 2
$3(s-2)=9$ $\frac{3(s-2)}{3}=\frac{9}{3}$ $s-2=3$ $s-2+2=3+2$ $s=5$	$3(s-2)=9$ $3s-6=9$ $3s-6+6=9+6$ $3s=15$ $\frac{3s}{3}=\frac{15}{3}$ $s=5$

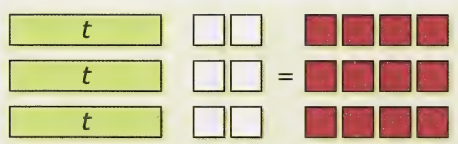
Check:

$$\begin{aligned}\text{Left Side} &= 3(s-2) \qquad \text{Right Side} = 9\\ &= 3(5-2)\\ &= 3(3)\\ &= 9\end{aligned}$$

Left Side = Right Side

The solution is correct.

6.a.



$$\begin{aligned}3(t-2)&=12\\ \frac{3(t-2)}{3}&=\frac{12}{3}\\ t-2&=4\\ t-2+2&=4+2\\ t&=6\end{aligned}$$

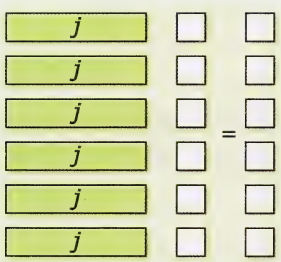
Check:

$$\begin{aligned}\text{Left Side} &= 3(t-2) \qquad \text{Right Side} = 12\\ &= 3(6-2)\\ &= 3(4)\\ &= 12\end{aligned}$$

Left Side = Right Side

The solution is correct.

b.



$$\begin{aligned}6(j-1) &= -6\\ \frac{6(j-1)}{6} &= \frac{-6}{6}\\ j-1 &= -1\\ j-1+1 &= -1+1\\ j &= 0\end{aligned}$$

Check:

$$\begin{aligned}\text{Left Side} &= 6(j-1) \qquad \text{Right Side} = -6\\ &= 6(0-1)\\ &= 6(-1)\\ &= -6\end{aligned}$$

Left Side = Right Side

The solution is correct.

10.a. No.

Check:

$$\begin{aligned}\text{Left Side} &= -8(x-1) \qquad \text{Right Side} = 24\\ &= -8(-4-1)\\ &= -8(-5)\\ &= 40\end{aligned}$$

Left Side = Right Side

The solution to the equation is not –4.

b. No.

c. Yes.

Check:

Left Side = 25

$$\begin{aligned}\text{Right Side} &= -5(x-1)\\ &= -5(-4-1)\\ &= -5(-5)\\ &= 25\end{aligned}$$

Left Side = Right Side

The solution of –4 is correct.

d. No.

11.a. Gisel wants to increase the length by 7 cm, so the new length will be $(s + 7)$ cm. There are three sides to the fence, and the perimeter of her new fence will be 183 cm. Therefore, a two-step equation which represents the situation is $3(s + 7) = 183$.

b. Each side of the old fence is 54 cm.

Method 1	Method 2
$3(s+7)=183$ $\frac{3(s+7)}{3}=\frac{183}{3}$ $s+7=61$ $s+7-7=61-7$ $s=54$	$3(s+7)=183$ $3s+21=183$ $3s+21-21=183-21$ $3s=162$ $\frac{3s}{3}=\frac{162}{3}$ $s=54$

Check:

$$\begin{aligned}\text{Left Side} &= 3(s+7)\\ &= 3(54+7)\\ &= 3(61)\\ &= 183\end{aligned}$$

Right Side = 183

Left Side = Right Side

The solution is correct.

16.a. Choose the variable s for Andrew's current speed. If he rides 2 km/h faster than his current speed, he would be riding at (s + 2) km/h. When the time is multiplied by the speed, you get the distance. In three hours, he will travel $3(s + 2)$ km. A two-step equation which represents Andrew travelling the 42 km to his grandfather's apartment is $3(s + 2) = 42$.

solution:
$$3(s+2)=42$$
$$\frac{3(s+2)}{3}=\frac{42}{3}$$
$$s+2=14$$
$$s+2-2=14-2$$
$$s=12$$

Check:
$$\text{Left Side}=3(s+2) \qquad \text{Right Side} = 42$$
$$=3(12+2)$$
$$=3(14)$$
$$=42$$
$$\text{Left Side} = \text{Right Side}$$

The solution is correct.

b. Let the increase in Andrew's speed be x. Because Andrew's current speed is 12 km/h, he should ride at (12 + x) km/h. Andrew wants to get there in two hours, so the two-step equation which represents Andrew travelling the 42 km to his grandfather's apartment is $2(12 + x) = 42$.

solution:
$$2(12+x)=42$$
$$\frac{2(12+x)}{2}=\frac{42}{2}$$
$$12+x=21$$
$$12-12+x=21-12$$
$$x=9$$

Check:
$$\text{Left Side}=2(12+x) \qquad \text{Right Side} = 42$$
$$=2(12+9)$$
$$=2(21)$$
$$=42$$
$$\text{Left Side} = \text{Right Side}$$

The solution is correct.

c. A variety of correct answers is possible. One example could be the following: Andrew may not get there in two hours if he is riding in the city because of steep hills, traffic, and traffic lights. His time of arrival would also depend on his athletic ability.

Unit Summary

SC 1. Check your answers using the solutions on page 506 in the textbook. Be sure to ask your teacher about a question if the answer does not make sense to you. You may do the additional questions if you feel you need the practice.

SC 2. Check your answers using the solutions on page 508 in the textbook. Remember to ask your teacher for assistance if a question gives you difficulty. You may do the additional questions if you feel you need the practice.

SC 3.

1. C

2. B

3. C

4. C

5. D

6. $-4(-1) + 2 = 6$

7. The y-coordinate **decreases** by **1**.

8.a. One can of Zap costs $3.

b. The following are patterns on the graph:

- For each can of Zap added, the cost increases by $3.
- The points lie in a straight line.
- The points all lie on cross-lines of the graph.

c. The first 0 would represent the purchase of no cans, and the second 0 would represent the cost, $0, of buying no cans of Zap.

9.a. Your table of values should look like the following.

Figure Number	Number of Dots
1	4
2	8
3	12
4	16
5	20

b. $b = 4f$

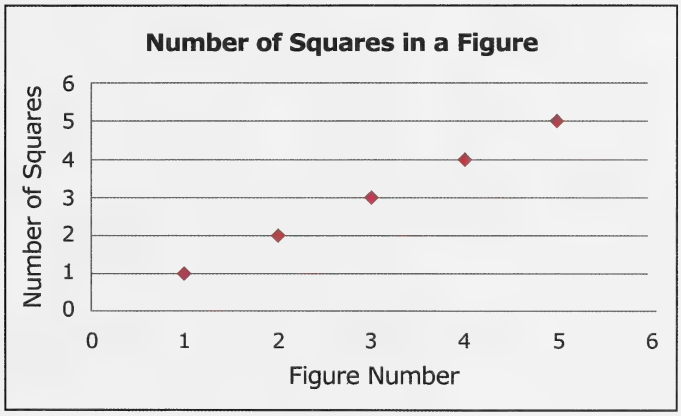
$240 = 4(60)$

There would be 240 black dots in Figure 60.

10.a.

Figure Number	Number of Squares
1	3
2	5
3	7
4	9
5	11

b.



c. The relationship is linear. An increase of 1 in the figure number results in 2 more small squares.

SC 4.

1. D

2. C

3. A

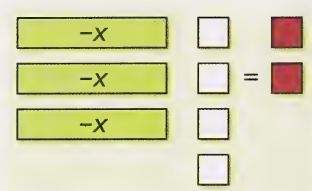
4. C

5. A

6. The opposite operation of division is **multiplication**.

7. The solution to $-4(y + 10) = 24$ is $y = \mathbf{-16}$.

8.a.



b. The equation has the solution $x = -2$.

9.a. $2x - 8 = 6$ is being modelled.

b. Dillon should add 8 positive 1-tiles to each side.

10.a.
$$4x = 48$$
$$\frac{4x}{4} = \frac{48}{4}$$
$$x = 12$$

Check:

Left Side	Right Side
$4x$	48
4×12	48
48	48

Left Side = Right Side

b.
$$\frac{t}{-5} = -8$$
$$-5\left(\frac{t}{-5}\right) = -5 \times (-8)$$
$$t = 40$$

Check:

Left Side	Right Side
$\frac{t}{-5}$	-8
$\left(\frac{40}{-5}\right)$	-8
-8	-8

Left Side = Right Side

c.
$$2k - 6 = 31$$
$$2k - 6 + 6 = 31 + 6$$
$$2k = 37$$
$$\frac{2k}{2} = \frac{37}{2}$$
$$k = 18\frac{1}{2}$$

Check:

Left Side	Right Side
$2k - 6$	31
$2\left(18\frac{1}{2}\right) - 6$	31
$37 - 6$	31
31	31

Left Side = Right Side

d.
$$\frac{d}{7}-5=16$$
$$\frac{d}{7}-5+5=16+5$$
$$\frac{d}{7}=21$$
$$7\left(\frac{d}{7}\right)=7(21)$$
$$d=147$$

Check:

Left Side	Right Side
$\frac{d}{7}-5$	16
$\frac{147}{7}-5$	16
$21-5$	16
16	16

Left Side = Right Side

e.
$$3-\frac{n}{4}=8$$
$$-3+3-\frac{n}{4}=-3+8$$
$$-\frac{n}{4}=5$$
$$-4\left(-\frac{n}{4}\right)=-4(5)$$
$$n=-20$$

Check:

Left Side	Right Side
$3-\frac{n}{4}$	8
$3-\frac{-20}{4}$	8
$3-(-5)$	8
8	8

Left Side = Right Side

f.
$$12=4(x-2)$$
$$\frac{12}{4}=\frac{4(x-2)}{4}$$
$$3=x-2$$
$$3+2=x-2+2$$
$$5=x$$

Check:

Left Side	Right Side
12	$4(x-2)$
12	$4(5-2)$
12	4×3
12	12

Left Side = Right Side

11.a. To solve $-3(b+3)=-15$, start by dividing both sides by -3. Then subtract 3 from both sides.

b. Solving $-3b+3=-15$ starts by subtracting 3 and is followed by dividing by -3.

12.a. Let a represent the elevation of Lake Athabasca. The equation $1536 = 45 + 7a$ can be used to find the elevation of Lake Athabasca.

b.
$$1536\text{ m}=45\text{ m}+7a$$
$$1536\text{ m}-45\text{ m}=45\text{ m}-45\text{ m}+7a$$
$$1491\text{ m}=7a$$
$$\frac{1491\text{ m}}{7}=\frac{7a}{7}$$
$$213\text{ m}=a$$

The elevation of Lake Athabasca is 213 metres.

13. The equation $90\ \text{m}^2 = (5\ \text{m})(l + 3\ \text{m})$ can be used to find the original length of the garden.

$$90\ \text{m}^2 = (5\ \text{m})(l + 3\ \text{m})$$
$$\frac{90\ \text{m}^2}{5\ \text{m}} = \frac{(5\ \text{m})(l + 3\ \text{m})}{(5\ \text{m})}$$
$$18\ \text{m} = l + 3\ \text{m}$$
$$18\ \text{m} - 3\ \text{m} = l + 3\ \text{m} - 3\ \text{m}$$
$$15\ \text{m} = l$$

The original length of the garden was 15 m.

14 a. The same amount must be added to each side of the equation. Here, 18 was added to the left side while –18 was added to the right side.

b.

$$-6 = 18 + 3x$$
$$-6 - 18 = 18 - 18 + 3x$$
$$-24 = 3x$$
$$\frac{-24}{3} = \frac{3x}{3}$$
$$-8 = x$$

The correct method is shown above.

15..

$$P = 2(l + w)$$
$$14\ \text{cm} = 2(l + 3\ \text{cm})$$
$$\frac{14\ \text{cm}}{2} = \frac{2(l + 3\ \text{cm})}{2}$$
$$7\ \text{cm} = l + 3\ \text{cm}$$
$$7\ \text{cm} - 3\ \text{cm} = l + 3\ \text{cm} - 3\ \text{cm}$$
$$4\ \text{cm} = l$$

Check:

Left Side	Right Side
P	$2(l + w)$
14 cm	$2(4\ \text{cm} + 3\ \text{cm})$
14 cm	$2(7\ \text{cm})$
14 cm	14 cm

Left Side = Right Side

The length of the rectangle is 4 cm.

b.

$$P = 2(l + w)$$
$$12\ \text{cm} = 2(4\ \text{cm} + w)$$
$$\frac{12\ \text{cm}}{2} = \frac{2(4\ \text{cm} + w)}{2}$$
$$6\ \text{cm} = 4\ \text{cm} + w$$
$$6\ \text{cm} - 4\ \text{cm} = 4\ \text{cm} - 4\ \text{cm} + w$$
$$2\ \text{cm} = w$$

Check:

Left Side	Right Side
A	$l \times w$
A	$(4\ \text{cm})(2\ \text{cm})$
A	$8\ \text{cm}^2$

Left Side = Right Side

This rectangle has an area of 8 square centimetres.